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ABSTRACT
# of the
DRAFT
ENVIRONMENTAL
STATEMENT
Proposed Foothills Project

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE

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August 1977

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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INTRODUCTION

This abstract contains copies of selected pages from the complete text of the Draft Environmental Statement (DES) on the proposed Foothills Project. It is believed these pages contain the essence of the DES and include those items which are considered most significant. Other material necessary for an overall understanding of the total project is included in summary form. No attempt is made here to generate new material or develop analysis in addition to or different from what is contained in the DES. The complete Table of Contents from the DES is included. All other items contained in the abstract are noted by an asterisk in the Table of Contents.

Copies of the complete draft environmental statement may be obtained by writing the Office of Public Affairs, Bureau of Land Management, Room 700 Colorado State Bank Building, 1600 Broadway, Denver, Colorado 80202.

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SUMMARY

(X) Draft ( ) Final Environmental Statement

Department of the Interior, Bureau of Land Management

1. Type of Action: (X) Administrative ( ) Legislative

2. Brief Description of Action: The Board of Water Commissioners for the City and County of Denver proposes to construct, operate, and maintain water diversion facilities on federally managed lands on the South Platte River 25 miles southwest of Denver, Colorado as a part of the proposed Foothills Project. The project would also include a water treatment plant with an ultimate capacity of 500 million gallons per day and a conduit distribution system extending into the Denver metropolitan area. Sources of water would include both the South Platte River and the Blue River via Dillon Reservoir and the Harold D. Roberts Tunnel.

3. Summary of Environmental Impacts:

   Results of the proposed action would include the loss of 1.7 miles of free-flowing river, 1,753 additional tons of sediments, 35 Bighorn sheep, most of the historical narrow gage railbed features, and about 18,000 recreation visits to the South Platte Canyon. The proposed action would also provide for adequate municipal and industrial water in the Denver Metro Area until sometime after 2001, positively impacting that area by maintaining existing life styles until that time.

4. Alternatives Considered:

   A. No Action. (Rejection of the Application)
   B. Major Alternatives
      1. Chatfield Alternative
      2. Upstream Dam
   C. Minor Alternatives
      1. Lower Dam
      2. Elevator Access to the Dam Crest
      3. 14 foot Roadway with Turn-Outs
      4. Buried Power and Telephone Lines
   D. Raw Water Sources Concepts
      1. Concept A
      2. Concept B
      3. Concept C

5. Comments Will Be Requested from the Following:

   See attached list

6. Date Statement Made Available to CEQ and the Public:

   Draft Statement:
   Final Statement:

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Table of Contents

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

Page

*Introduction 1-1
    *Summary 1-1
    *Background and History 1-6
*Government Actions 1-7
    *Bureau of Land Management 1-7
    *United States Forest Service 1-9
    Federal Power Commission 1-9
    Corps of Engineers 1-11
    Colorado Department of Health 1-11
    Local Governmental Agencies 1-12
Proposed Action 1-12
    Purpose and Need 1-12
    *Description of the Proposed Foothills Project 1-20
        *General Facilities Description 1-20
        *Project Elements 1-27
Interrelationships 1-57
    Interrelationships with Other Projects and Proposals 1-57
        Existing Non-Federal Projects 1-57
        Existing Federal Projects 1-59
        Planned Developments and Proposals 1-60
    Interrelationships with Bureau of Land Management Multiple Use Planning System in the Study Area 1-61

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

PRESENT ENVIRONMENT

Socio-Economic Conditions 2-1
    Human Populations 2-1
    Employment and Manpower 2-2
    Income 2-2
    Utilities 2-5
        Municipal and Industrial Water Systems 2-5
        Wastewater Treatment Facilities 2-8

  - Law Enforcement 2-9
  - Fire Protection 2-9
  - Community Attitudes........ 2-10
  - Life Styles 2-12
- Water Resources 2-14
  - Present Raw Water Supply Systems 2-14
    - Moffat System 2-15
    - Roberts Tunnel System 2-17
    - South Platte System 2-17
  - Water Rights........ 2-21
  - Flows and Reservoir Levels 2-21
    - Roberts Tunnel System 2-21
    - South Platte System 2-25
  - Ground Water 2-29
  - Water Quality 2-30
- Aquatic Resources 2-33
  - Fish Populations 2-33
  - Bottom Fauna 2-37
  - Aquatic Vegetation 2-41
  - Amphibians 2-41
- Geology, Minerals, and Topography 2-41
  - Topography and General Geology 2-41
  - Geologic Processes 2-44
  - Minerals 2-45
  - Geologic Hazards and Problem Areas 2-45
    - Faults, Joints, Seismic Activity, and Earthquake Hazard 2-45
    - Slides and Rock Falls 2-46
- Soils 2-47
  - Soil Descriptions and Interpretations 2-47
  - Sediment Yields 2-47
- Terrestrial Resources 2-51
  - Vegetation 2-51
  - Wildlife 2-56
    - Bighorn Sheep 2-60
  - Endangered Species 2-62
    - Peregrine Falcon 2-62
  - Other Animal Species 2-63
- Climate and Air Quality 2-64
  - Temperature 2-64
  - Precipitation 2-64
  - Ambient Moisture and Evaporation 2-65
  - Winds 2-65
  - Air Pollution 2-65
- Noise 2-66
- Visual Resources 2-66
- Cultural Resources 2-74
  - Archaeological Resources 2-74
  - Historical Resources 2-75
  - Paleontological Resources 2-80

Recreation Resources 2-80
    Waterton Canyon 2-80
    South Platte River-South Platte to Cheesman Reservoir 2-81
    North Fork of the South Platte River 2-83
    Treatment Plant Site 2-83
Land Use 2-84

FUTURE ENVIRONMENT WITHOUT THE PROPOSED ACTION

*Introduction 2-91
*Socio-Economic Implications 2-93
*Water Resources 2-95
Aquatic Resources 2-99
Geology, Minerals, and Topography 2-99
Soils 2-99
Terrestrial Resources 2-100
Climate and Air Quality 2-100
Noise 2-101
Visual Resources 2-101
Cultural Resources 2-101
Recreation Resources 2-102
Land Use 2-103
*Summary of Features of Existing and Future Environment 2-108

CHAPTER 3

ENVIRONMENTAL IMPACT OF THE PROPOSAL

*Assumptions and Analysis Guidelines 3-1
Socio-Economic Conditions 3-5
    Human Populations 3-5
    Employment and Manpower 3-5
    Accidents 3-6
    Income 3-6
Utilities 3-8
    Municipal and Industrial Water Systems 3-8
    Wastewater Treatment Facilities 3-12
    Community Life Styles 3-12
Water Resources 3-12
    Surface Water 3-12
        Colorado River Watershed 3-13
        South Platte River Watershed 3-13
    Water Quality 3-19
    Ground Water 3-21
Aquatic Resources 3-22
Geology, Minerals, and Topography 3-25
Soils 3-27

Terrestrial Resources 3-32
    Vegetation 3-32
    Wildlife 3-33
        Bighorn Sheep 3-33
    Endangered Species 3-34
        Peregrine Falcon 3-34
        Southern Bald Eagle 3-34
    Other Animal Species 3-34
    Golden Eagle 3-34
    Deer and Other Big Game 3-34
Climate and Air Quality 3-35
Noise 3-36
Visual Resources 3-41
    Inundation and Increased Stream Flows 3-42
    Strontia Springs Dam 3-46
    Dam Crest Road 3-48
    Road Widening 4-48
    Staging Area 3-48
    Power and Telephone Lines 3-53
    Foothills Treatment Plant 3-53
    Conduit No. 27 and Second Parallel Conduit 3-54
Cultural Resources 3-54
    Archaeological Resources 3-54
    Historical Resources 3-54
    Paleontological Resources 3-56
Recreation Resources 3-56
Land Use 3-59
*Summary of Environmental Impacts of the Proposal 3-62

CHAPTER 4

MITIGATING MEASURES

*Introduction 4-1
Measures 4-1
    Right-of-Way: Dam, Reservoir, and Tunnel 4-1
        Bureau of Land Management 4-1
    Right-of-Way: Access Roads 4-6
        Bureau of Land Management 4-6
    Right-of-Way: Power and Telephone Lines 4-6
        Bureau of Land Management 4-6
Analysis of Effectiveness 4-9
    Vegetation 4-9
    Aquatic Resources 4-11
    Recreation 4-11
    Historical Resources 4-13
    Archaeological Resources 4-13

Paleontological Resources 4-13
Air Quality 4-14
Visual Resources 4-14
Terrestrial Resources 4-15
Summary of Analysis of Effectiveness 4-15
Monitoring Research and Study Programs 4-19
Water Quality 4-19
Wildlife 4-19
Geology 4-19
Archaeology and Paleontology 4-20

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

*Introduction 5-1
Socio-Economic Impacts 5-1
Water Resources 5-2
Surface Water 5-2
Water Quality 5-2
Aquatic Resources 5-3
Soils 5-3
Geology, Minerals, and Topography 5-5
Terrestrial Resources 5-5
Climate and Air Quality 5-8
Noise 5-8
Visual Resources 5-9
Inundation and Increased Stream Flows 5-9
Strontia Springs Dam 5-10
Dam Crest Road 5-11
Road Widening 5-12
Staging Area 5-12
Power and Telephone Lines 5-12
Foothills Treatment Plant 5-12
Conduit No. 27 and Second Parallel Conduit 5-14
Cultural Resources 5-14
Archaeological Resources 5-14
Historical Resources 5-14
Paleontological Resources 5-16
Recreation 5-16
Land Use 5-17
*Summary of Adverse Impacts Which Cannot be Avoided 5-18

CHAPTER 6

* THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

CHAPTER 7

*IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

*Major Alternatives 8-1
  *No Action 8-1
    Description 8-1
    Analysis 8-1
  *Chatfield Alternative 8-16
    Description 8-16
    Analysis 8-17
  *Upstream Dam Alternative 8-20
    Description 8-20
    Analysis 8-22
Minor Alternatives 8-26
  Lower Dam 8-26
    Description 8-26
    Analysis 8-26
  Elevator Access to the Dam Crest 8-27
    Description 8-27
    Analysis 8-28
  Fourteen-Foot Standard Road with Turnouts 8-28
    Description 8-28
    Analysis 8-28
  Underground Power and Telephone Lines 8-28
    Description 8-28
    Analysis 8-29
  Parallel Bridge to the Keystone Bridge 8-29
    Description 8-29
    Analysis 8-29
*Alternate New Sources of Raw Water 8-29
  *Introduction 8-29
    General 8-29
    Criteria for Water Supply Concepts 8-31
  *Concepts 8-32
    Concept A 8-32
    Concept B 8-72
    Concept C 8-93

CHAPTER 9

CONSULTATION AND COORDINATION

History of Coordination Efforts 9-1
Consultation and Coordination in Preparation of the DES 9-2
    Federal Agencies Contacted 9-2
    State Agencies, Municipal Agencies, and Interest Groups Contacted 9-3
    Comments on Original Draft Environmental Statement 9-5
Coordination in the Review of the Draft Environmental Statement 9-7

APPENDICES

Appendices

Glossary

Literature Sources Cited

CHAPTER 1

DESCRIPTION OF THE PROPOSED ACTION

INTRODUCTION

Summary

The Board of Water Commissioners for the City and County of Denver (also known as Denver Water Department and hereinafter referred to as the Denver Water Board (DWB)) has applied to the Bureau of Land Management (BLM) for the right to construct, operate, and maintain water-diversion facilities on federally managed lands along the South Platte River approximately 25 miles southwest from downtown Denver, Colorado (Map 1-1). These facilities are a part of a larger DWB proposal known as the Foothills Project. The project would increase the DWB nominal treatment capacity by 125 million gallons per day (mgd), with the capability of expansion to 500 mgd. All components of the proposed Foothills Project are designed to accommodate expansion to a capacity of 500 mgd in the event that population in the DWB treated water service area grows as projected and future additional raw water supplies are developed to satisfy the water needs of the growing population.

The Foothills Project would use water stored during peak spring runoff in the existing Antero, Eleven Mile Canyon, and Cheesman Reservoirs as well as direct flows from the rivers. As needed, west slope water from Dillon Reservoir would be released through the existing Roberts Tunnel and down the North Fork of the South Platte River to supplement direct South Platte reservoir releases. The water would be diverted from the South Platte River by the proposed Strontia Springs Dam and Reservoir into a tunnel (Foothills Tunnel) and conduit (No. 26) system to the proposed treatment plant, about three miles northeast (Map 1-2).

Approximately 11 million kilowatt hours of hydroelectric power would be generated annually at 125 mgd and 78 million kilowatt hours generated annually at 500 mgd by the water near the terminal point of Conduit No. 26. Of this power, 8 million kilowatt hours would be utilized at 125 mgd and 13 million at 500 mgd, to operate the plant. "Raw" water would be treated and passed into another conduit (No. 27) for delivery to the Denver metropolitan area 16 miles northeast (Maps 1-2, 1-3, 1-4). A second identical conduit will be built parallel to Conduit No. 27 when the treatment plant is expanded to 500 mgd. The proposal also includes an intertie conduit with the City of Aurora's raw water system.

Background and History

In the early 1900s, plans were devised to divert and use water from the Upper South Platte and Blue Rivers to serve customers in the Denver area. Use of these waters began with the construction of Cheesman Dam in 1905 and was expanded in the 1930s with the purchase of Antero Reservoir and the construction of Eleven Mile Reservoir on the South Platte system. In 1963, Roberts Tunnel and Dillon Reservoir were completed by the DWB for diversion of west slope water from the Blue River system to the east slope.

Serious plans for the proposed Foothills Project were initiated by the DWB during 1952-1955 with a preliminary survey of the Foothills Tunnel and the treatment plant site. In 1956, the DWB prepared the first plans for Strontia Springs Diversion Dam and purchased 200 acres for a treatment plant. In 1957, the route of proposed Conduit No. 27 to Denver was surveyed. In 1962, the DWB filed its original application for those parts of Strontia Springs Diversion Dam and Reservoir, Conduit No. 26 and the Foothills Tunnel on federally managed lands as a part of the proposed Foothills Project. A report to the DWB (Black and Veatch 1963) recommended completion of the first treatment plant unit in 1977.

In 1967, BLM issued a right-of-way permit (C-099597), which allowed the DWB five years to construct the Strontia Springs Diversion Dam and Reservoir, conduits, and tunnel. In 1973, the DWB requested and was granted an extension of time, to submit an amended application based on changes in the original design and to complete construction. The letter from BLM granting the extension indicated the need for analysis of the action in compliance with Public Law (PL) 91-190, the National Environmental Policy Act of 1969 (NEPA). DWB studies culminated in the Foothills Predesign Report in November 1973 and the Foothills Project, Environmental Impact Assessment in April 1974. In January 1974 the DWB filed another request for a one-year extension of time to prepare and submit an amended filing and for three years to construct. After receiving these amended filings, BLM decided to comply with NEPA prior to acting on DWB's request.

An amendment to the original right-of-way permit was received from the DWB in November 1974. A new application for road access to the proposed damsite across federally managed land was filed in October 1974. From these applications the Department of the Interior determined that the action as proposed could significantly affect the quality of the human environment and began preparation of this environmental impact statement, as required by Section 102(2)(C) of NEPA. In February 1975, the Department determined that this environmental impact statement should be project-specific in scope and consider the effects of construction and operation of the dam, reservoir, ancillary facilities in the canyon of the South Platte River, the treatment plant, and the water supply, along with delivery tunnels and conduits.

This original draft environmental statement was filed with the Council on Environmental Quality (CEQ) December 1975 and issued in January 1976. Public hearings were conducted February 19, 1976. July 8, 1976, the Regional Solicitor ruled that the scope of this draft environmental statement was insufficient as a matter of law, and recommended that the Secretary of the Interior postpone his decision on the Foothills proposal pending comprehensive analysis.

On November 1, 1976, the Under-Secretary of the Department of the Interior for Land and Water Resources sent a memorandum to the Colorado State Director of the BLM outlining the requirement for a new draft environmental statement covering the proposed Foothills Project. A supplementary memorandum from Mr. Horton on December 27, 1976, further elucidated the requirement for an expansion of the existing draft statement, for the express purpose of providing a sound basis for decision-making between the Department of the Interior, the State of Colorado, and the DWB. The scope of the potential impacts studied was enlarged to include the effects of the treatment plant being implemented at the 500 mgd level and a discussion of new sources of raw water needed to meet the 500 mgd capacity of the Foothills Treatment Plant.

GOVERNMENTAL ACTIONS

This section includes a description of actions required to approve or disapprove all or any part of the proposed action by issuing or not issuing a permit, grant, right-of-way, or license. Agencies discussed are the Bureau of Land Management, the United States Forest Service, the Federal Power Commission, Corps of Engineers, the Advisory Council on Historic Preservation and the Colorado Department of Health, each of which would issue necessary grants or permits under their respective authorities.

Bureau of Land Management

The DWB has filed two right-of-way applications with BLM. The first application, dated October 4, 1974, and identified by serial number C-22081, is for the Platte Canyon Road. The second application, dated November 4, 1974, is an amendment of right-of-way C-099597 for the Strontia Springs Diversion Dam, Reservoir, and Foothills tunnel.

The amendment would affect a right-of-way originally granted April 20, 1967, using as authority the Act of February 15, 1901 (31 Stat. 790; 43 U.S.C. 959) as to public lands, and Section 1 of the Act of February 1, 1905 (33 Stat. 628; 16 U.S.C. 524) as to national forest lands.

Both of these Acts were repealed by Section 706 of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2793). Section 501 of the Act authorizes the Secretary of the Interior to grant rights-of-way over, upon, under, and through the public lands for the various purposes that would satisfy the DWB municipal water development plans described in their pending applications. While regulations have not been issued to implement Sections 501 through 511 of the Act with respect to rights-of-way, this is the authority under which DWB would be permitted to use public land for the Foothills Project.

The applications filed include the following features, outlined in Table 1-1. The rights-of-way limits shown are preliminary estimates of the widths that would be permitted under Section 504(a)(1) through (4) of the Act.

TABLE 1-1

SUMMARY OF RIGHT-OF-WAY APPLICATIONS
ON BUREAU OF LAND MANAGEMENT LAND

Feature	Right-of-Way Limits	Area or Distance BLM Lands
Strontia Springs Dam, Reservoir	50 feet from marginal limits of maximum pool level	22 acres
Platte Canyon access road, including 1,696 feet on BLM land which would be inundated by the proposed reservoir	50 feet each side of center line	29 acres (12,629 feet)
Total		51 acres

If approved, the right-of-way grants would allow the DWB a reasonable but as yet undetermined time within which to construct the facilities described and give the DWB the right to operate and maintain those facilities for the duration of beneficial use. The grants would not give the DWB any estate of any kind in fee in the lands involved. The interest granted would not allow the removal of any material except that necessary for the construction of the project.

If rights-of-way are granted, two other permits would be necessary. The Public Service Company of Colorado would file for an extension of a 13.2-kilovolt overhead power line of about 2.8 miles from the South Platte Intake to the dam site of which 1.4 miles would be on BLM land. Mountain Bell would file for extension of a telephone line over the same distance, attached to the same poles.

The final decision regarding such land use authorizations would consider environmental factors, land use criteria, and economic considerations. The final environmental impact statement including the actions applied for must be filed with the Council on Environmental Quality for at least 30 days before a final decision can be rendered.

The decisions for the two rights or way (dam and road) lie with the Director of the Colorado State Office, BLM, with prior review and concurrence by the Director, BLM.

United States Forest Service

The DWB application to amend the right-of-way C-099597, for the Strontia Springs Dam, Reservoir and the Foothills Tunnel, which this environmental statement addresses, involves a right-of-way originally granted April 20, 1967 by the BLM, under authority of Section 4 of the Act of February 1, 1905 (33 Stat. 628; 16 U.S.C. 524) as to national forest lands involved. This act was repealed by Section 706 of the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2793). Section 501 of the Act authorizes the Secretary of Agriculture to grant rights-of-way over, upon, under, and through national forest lands for the various purposes that would satisfy the DWB municipal water development plans described in the application to amend C-099597. The U.S. Forest Service will grant one permit for five rights-of-way to DWB. These separate rights-of-way are described in Table 1-2.

Federal Power Commission

Pursuant to Part I of the Federal Power Act of June 10, 1920 (41 Stat. 1075) as amended, the Federal Power Commission (FPC) is responsible for licensing non-Federal hydroelectric projects located on streams over which Congress has jurisdiction, or projects which affect

TABLE 1-2

SUMMARY OF RIGHT-OF-WAY APPLICATIONS ON NATIONAL FOREST LANDS

Feature	Right-of-Way Limits	Area or Distance (U.S. Forest Service Lands)
Strontia Springs Dam, Reservoir	50 feet from marginal limits of maximum pool level	16 acres
Foothills Tunnel	50 feet each side of center line	10 acres (4,457.86 feet)
Dam abutment road	50 feet each side of center line	2 acres (848.83 feet)
Dam outlet works road	50 feet each side of center line	2 acres (885.78 feet)
Platte Canyon access road (including 1,802 feet which would be inundated by the proposed reservoir)	50 feet each side of center line	30 acres (12,870.45 feet)
Total		60 acres

TABLE 1-3

SUMMARY OF AUTHORIZING ACTIONS

Project Component	Required Authorization	Responsible Federal, State, or Local Agency
Dam, Reservoir, and Tunnel	Right-of-way permit	Bureau of Land Management
Dam, Reservoir, and Tunnel	Right-of-way permit	U.S. Forest Service
Dam, Reservoir, and Tunnel	Hydropower generation license	Federal Power Commission
Dam, Reservoir, and Tunnel	Section 404 permit	Corps of Engineers
Dam, Reservoir, and Tunnel	Sec. 106 Determination	Advisory Council on Historic Preservation
Dam, Reservoir, and Tunnel	Stream discharge permit	Colorado Department of Health
Access Roads	Right-of-way permit	Bureau of Land Management
Access Roads	Right-of-way permit	U.S. Forest Service
Access Roads	Section 404 permit	Corps of Engineers
Access Roads	Sec. 106 Determination	Advisory Council on Historic Preservation
Access Roads	Stream discharge permit	Colorado Department of Health
Power and Telephone Lines	Right-of-way permit	Bureau of Land Management
Power and Telephone Lines	Right-of-way permit	U.S. Forest Service
All Project Components	Special land use permits	Various units of local government

that population in the DWB treated water service area grows as projected and future additional raw water supplies must be developed. The exception is distribution Conduit No. 27, which is designed to accommodate only 350 mgd.

Operation of the Foothills Treatment Plant at capacity (500 mgd) would create a demand for 773 cfs of raw water on the South Platte River at the Strontia Springs Diversion Dam. If the Marston and Kassler Treatment Plant intakes are also diverting water at capacity, there will be demand for a total of 1,176 cfs of raw water from the South Platte River (for producing treated water at the rate of 760 mgd). Sources from which this year 2001 demand for raw water would be met are the DWB's existing South Platte and Roberts Tunnel Systems and potential additional sources or combinations of sources discussed in Chapter 8.

The addition of the proposed 125 and 500 mgd Foothills Treatment Plant is anticipated to change the pattern of operation of existing DWB treatment plants. Except during brief periods for maintenance, the Foothills Treatment Plant would operate at or near capacity on a year-around basis, in order to take advantage of its higher elevation (5,860 feet). Figure 1-1 shows the relative elevations of the various DWB storage reservoirs. The higher elevation of Foothills Treatment Plant would reduce the amount of pumping required for distributing treated water throughout the DWB treated-water service area. The Moffat, Marston, and Kassler Treatment Plants would be used primarily to supply the peak demands of the summer and, as necessary, to augment the treated water supply required during other times of the year.

The initial 125 mgd operating capacity would increase the total DWB treatment capacity to 645 mgd. Increasing the Foothills Plant to 500 mgd would provide a total of 1,020 mgd treatment capacity.

Construction of the Foothills project would provide for an electric power savings over the present operational system. This power savings at the 125 mgd development level would be 16 million kilowatt-hours and at the 500 mgd development level would be 47.9 million kilowatt-hours.

Description of the Proposed Foothills Project

General Facilities Description

The description of the proposed facilities which follows is comprised of information obtained from The Foothills Project Environmental Assessment (DWB 1974), The Foothills Project Predesign Report (Board of Water Commissioners 1973), BLM official case files for rights-of-way C099597

(Strontia Springs Dam and Reservior, conduits, and tunnel) and C-22081 (Platte Canyon access road) and additional data supplied by DWB. All details in the description are current as of January 1977. All components described would be needed for implementation at both the 125 and the 500 mgd level.

The proposed construction of the Foothills Project would cost about $234 million (1976). Table 1-6 reflects total resources which would be committed to project construction at 500 mgd, including first 125 mgd increment cost.

TABLE 1-6

SUMMARY OF PROJECT MATERIALS

	Initial 125 mgd unit	Expansion to 500 mgd	Total
Aggregate	300,000 tons	150,000 tons	450,000 tons
Cement	48,000 tons	25,000 tons	73,000 tons
Steel	10,000 tons	9,000 tons	19,000 tons
Water	90-100 acre-feet	90-100 acre-feet	180-200 acre-feet

The construction of the first 125 mgd increment would employ as many as 460 persons working three eight-hour shifts seven days a week (Figure 1-2). For purposes of impact analysis, a probable construction schedule (Figure 1-3) was developed by the DWB from a hypothetical starting date of May 1, 1978.

The construction of the 500 mgd plant would employ as many as 190 persons working three eight-hour shifts seven days a week for more than six years (Figure 1-4). A construction schedule (Figure 1-5) would begin in 1986 and continue through 1998. As described in the Proposed Action section of this chapter, the year 2001 will be used to measure impacts.

Project Elements

Dam and Reservoir

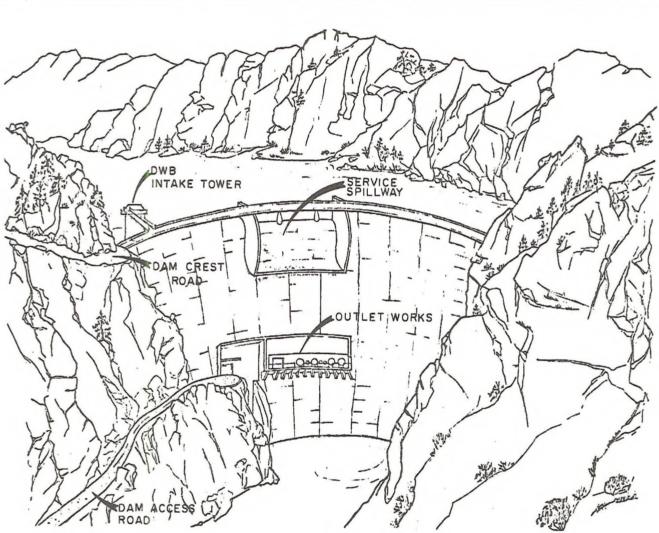
The proposed concrete Strontia Springs Diversion Dam would rise 243 feet above the existing channel, with curves on both horizontal and vertical planes and of a thin-arch configuration (Figure 1-6); the crest of the spillway would be at an elevation of 6,002 feet. The dam would be approximately 31 feet thick at the base and 10 feet wide at the crest, with a crest length of 601 feet (Figure 1-7).

At its normal level of 6,002 feet, the reservoir would extend approximately 1.7 miles upstream with a shoreline of 4.9 miles. Maximum pool depth would be approximately 240 feet immediately behind the dam, where the reservoir would be about 400 feet wide. The reservoir would have 2,110 acre-feet of dead or sediment storage capacity which would be sufficient to retain sediment for about 75 years.

The outlet-control valve system would be at the lower center of the dam. It would be comprised of four 48-inch, two 18-inch, and two 8-inch ring jet valves and have a maximum discharge capacity of 4,000 cubic feet per second (cfs) with a water level of 6,002 feet. Two free-standing intake towers would be constructed upstream of the east abutment of the dam. The DWB hexagonal tower would be about 35 feet wide at the base and rise about 179 feet to an elevation of 6,029 feet. The Aurora tower would be about 21 feet square at the base and rise 123 feet to that same elevation. Slide gates and trash racks would be located on four faces of the DWB structure and three faces of the Aurora structure and be set at distances of approximately 23 feet apart. A footbridge would provide access from the service road to the intake towers.

The main service spillway would be located at the top center of the structure. An emergency spillway would be located in the left (facing downstream) abutment of the dam. With a reservoir water level elevation of 6,012.5 feet, the outlet works and the service spillway would have a capacity of 16,000 cfs. Above elevation of 6,012.5 feet and up to an elevation of 6,029 feet, flood water would also be discharged over the emergency spillway, resulting in a combined capacity of 90,000 cfs from both the spillways. Under these conditions, flows over the dam crest would be 27 feet deep. A plunge pool 120 feet long, 90 feet wide, and 25 feet deep in the natural rock would be immediately downstream from the dam. A bridge over the center spillway would provide vehicle access across the crest of the dam to the emergency spillway.

Because the river occupies most of the narrow valley, diversion facilities would have to be built before any foundation excavation could begin in the riverbed. The normal stream channel would be diverted through a temporary system involving a diversion tunnel and cofferdams (Figure 1-7). The tunnel and diversion system would be disigned to withstand 25 year flood flows and pass 4,440 cfs. Construction of the tunnel,



PROPOSED STRONTIA SPRINGS
DAM & RESERVOIR

FIGURE I-6

PREPARED BY FOOTHILLS PROJECT CONSULTANTS

18 feet in diameter, would begin at approximately 250 feet upstream of the axis of the dam, at a portal in the left river bank, and continue downstream about 700 feet to a point approximately 350 feet below the dam. The upstream portal would house a bulkhead gate for temporary tunnel closure. A 38-foot concrete plug would be poured in the tunnel at the dam axis for permanent tunnel closure after construction. One cofferdam would be constructed upstream of the damsite to divert the river into and through the diversion tunnel. Above the point where the stream flow returns to the established channel, another dam would be built downstream. Construction of the cofferdams would use approximately 6,700 cubic yards of spoil (mostly rock) from the diversion tunnel and impervious material from an existing 1 acre borrow area near the Kassler Treatment Plant (Map 1-2). The faces of the cofferdams would be riprapped to protect them from erosion. The estimated 1,500 cubic yards of material contained in the lower cofferdam would be completely removed and deposited in Stevens Gulch to reduce stream sedimentation after completion of construction. Construction of the bypass tunnel would involve drilling, blasting, and removing tunnel muck. About 1 acre would be available as a staging area for construction between the two cofferdams.

After completion of diversion facilities, dewatering of the stream channel and excavation in the riverbed would begin. After construction of the dam the plunge pool would be excavated. From the excavation, spoil material estimated at 130,000 cubic yards would be disposed of by filling side gulches below the elevation of 5,935 feet in the reservoir area. Metal culverts would be placed under the fill to drain the side gulches into the river to minimize erosion. Overflow weirs would also be provided. The excavation would cause cuts into the rock, approximately 60 feet deep into the valley floor and 35 feet into the left and right abutments. The DWB expects there would be some seepage of water as a result of this excavation, and proposes that the contractor be responsible for pollution abatement measures. The DWB would secure the necessary stream-discharge permits from the Colorado Department of Health. It is expected that high turbidity would occur for a short period of time during the actual diversion of the river. Blasting would occur throughout the excavation operation about twice a day on a regular schedule.

The excavation for the dam abutments would not affect the operation of Aurora's facilities near the damsite except that precautions would be required during excavation above Aurora's existing structures. Aurora's water service should not be interrupted except in the case of an accident or for a short period when excavation is completed between the Aurora intake tower and Tunnel No. 1. The existing Aurora intake and conduit upstream would be abandoned in place and would eventually be inundated by the proposed reservoir.

Although a variety of methods exist for handling concrete operations, the one which most probably would be used is summarized in the following paragraphs.

The DWB has identified sources of aggregate, for use in making concrete, in the South Platte River Valley, about 1 mile downstream from Kassler (Map 1-3). Specifically, the aggregate would be mined within the Chatfield Reservoir area from the zone lying between the perimeter of the static pool and the high-water line. The gravel would be washed and screened at the gravel source and hauled 8 miles to the concrete batching area which would probably be located in Stevens Gulch. About 109,000 cubic yards would be hauled from this source over the Platte Canyon road. Since there is not sufficient area for aggregate storage at the Stevens Gulch staging area, it is probable that hauling would be necessary throughout the dam construction period - seventeen months - averaging about twenty truckloads per day (assuming use of trucks with a capacity of 10 cubic yards).

The mixed concrete would probably be transferred to hoisting-placing equipment at the valley floor. To support this equipment, two 4-foot-thick concrete foundation blocks would be placed on the natural rock floor of the canyon. These blocks would be incorporated into the dam structure or removed after use. Cable-ways or tower cranes would move the concrete.

Approximately 117 acres of vegetation in the reservoir would be cleared in the area of the maximum pool to the 6,029-foot elevation. Marketable timber would be cut and removed from the canyon; other logs would be cut and sold as firewood. The balance would be chipped and disposed of as mulch in disturbed areas above the high-water line (6,029-foot elevation).

Upon completion of the project, releases of stored water and the flows through the rivers to the Foothills system would be a function of water demands made by the customers of the City and County of Denver. Water released from Dillon Reservoir would flow through the Roberts Tunnel into the North Fork of the South Platte River. A stream gage near Stevens Gulch would be used to measure flows in the South Platte River below the Strontia Springs Dam.

Raw water from the reservoir would enter the Foothills Tunnel and the Aurora tunnel system (existing) via the gates on the intake towers. During periods of operations at the 125-mgd rate, water turnover at the reservoir would occur every twenty days; at 500 mgd, turnover would approximate five days. This would also be the length of the silt-settling period. Fluctuation would be very slight, the pool normally being relatively stable at 6,002 feet of elevation.

The caretaker, who lives immediately downstream from the existing Platte Canyon intake, would operate these gates as well as those on the outlet works. The dam facility would be lighted to accommodate night operation.

Access Roads and Staging Areas

Access roads and staging areas are proposed to support the construction operation (Map 1-2). During construction, the existing access road in the South Platte Canyon would be closed to all uses not related to construction. The existing road from the Platte Canyon intake to Stevens Gulch, about 13,950 feet in length, would be improved to accommodate construction traffic. The road would have a 2 to 3 percent grade and a general roadway of 22 feet over a distance of about 13,900 feet. Typical road cross-sections are shown in Figure 1-8.

Only one crossing of the South Platte River would be necessary - at the location of the existing narrow gage railroad bridge. That structure would be replaced by a steel beam-concrete deck bridge with a 22-foot running surface employing the existing abutments. Plans call for the Keystone Bridge to be carefully dismantled, piece-marked, and stored at Kassler for future use as appropriate.

Culverts would be installed at all drainage crossings except at Mill Gulch and Stevens Gulch, where paved waterway sections would be placed. These sections would be located over culverts to allow passage of normal runoff. Additional fill material would be added to the existing roadway in the canyon, raising the roadbed a maximum of 5 feet, to reduce possible damage from flooding. The design of the canyon road as proposed does not include any road cuts or fills that are not absolutely necessary. However, some cuts and fills cannot be avoided. These areas are estimated at less than 5 acres; in these areas the DWB proposes to place topsoil on the fills and plant them with appropriate ground cover. The widening would require about 5 additional acres for the roadbed.

At Stevens Gulch the road would fork. The left fork would have a 22-foot roadway and would extend up and beyond Stevens Gulch 5,000 feet to the right abutment of the dam crest. This road would switch back about 2,000 feet up the gulch and contour back for another 3,000 feet at a grade of nearly 10 percent. That last 3,000 feet would require the only new road construction in the Platte Canyon. It would permanently displace approximately 2 acres and disturb an additional 2 acres.

The right fork from Stevens Gulch would have a 22-foot roadway and would follow the existing road along the river to the base of the dam site, a distance of about 1,500 feet. About 1 acre would be devoted to road widening. Rehabilitation would not be practical.

The existing road, which would be located in the dam and reservoir area and would later be inundated, would be maintained with only minimum upgrading. The existing road upstream from the proposed reservoir would be improved to provide a 13-foot roadway with turnouts over a distance of 6,400 feet, from the upstream end of the reservoir to the town of South Platte. This road would be used to transport some of the workers to the site to reduce traffic on the downstream road. This proposed improvement would involve widening only where possible, would require about 1 additional acre for roadway, and would also disturb about 1 acre which would be smoothed and seeded later.

Approximately 125,000 cubic yards of fill material generated from roadway excavation and 15,000 cubic yards of material supplied from a borrow area near Kassler would be used in constructing roads. All roads would be surfaced with a 6-inch layer of gravel and treated with a nontoxic bituminous liquid (Pentaprime, a petroleum pitch with kerosene cutter stock; for pitch chemical qualities check Toxic Substances Control Act, Item *61789-60-4 B405-5588; for cutter stock chemical qualities check Toxic Substances Control Act, Item *8008-20-6 B032-5147) to control dust. The road construction would use approximately 12,500 cubic yards of gravel from a DWB stockpile located 3 miles north of Stevens Gulch on DWB property.

Reclamation to establish a vegetative cover along the roads would be accomplished by replacing topsoil and seeding. An estimated 6,500 cubic yards of topsoil would be required and would probably be obtained from an existing stockpile on private land north of Kassler near the probable gravel source. The proposed roads would involve the use of about 9 additional acres for access purposes and disturb another 8 acres.

During construction most of the workers in the canyon would be bussed to the worksites from Kassler. Roads constructed and upgraded for the construction of the proposed project would later be used by the plant operation and maintenance personnel for access to the dam and reservoir and the Stevens Gulch common portal. The road from South Platte to the upper end of the reservoir would be used for maintenance and access to the gaging station below South Platte. Hiking and bicycle recreation traffic would use the canyon roads for access after completion of construction.

Existing Douglas County graveled roads, No. 5 and No. 7, would be used for access south from Kassler. An unsurfaced, bladed road would be constructed parallel to Conduit No. 27 for access during construction. This road would be reclaimed and seeded after construction is completed. Existing roads would be utilized for maintenance and operation access to the proposed line while the reclaimed construction road would be used for access along the proposed conduit for continuous operation and maintenance.

In addition to the area at the dam site, principal staging areas probably would include about 4 acres in Stevens Gulch and approximately 30 level acres at the east portal of the tunnel. Material excavated during construction of the road to the dam crest would be placed in Stevens Gulch to form that staging area (Figure 1-9). The access road would bypass the area on its west side. Drainage from Stevens Gulch would be rerouted along the east side.

All staging areas would have portable sanitary facilities provided by a reputable sub-contractor, who would be required to service these facilities on a regular schedule. The staging area at the east portal would require grading on the 30-acre location, including that immediately adjacent to the portal (Figure 1-10).

In Stevens Gulch, after completion of construction of the west portal the staging areas would be covered with topsoil and planted with vegetation. Topsoil would probably come from the area north of Kassler.

The staging area at the east portal also would be rehabilitated with topsoil and reseeded after construction has been completed. Topsoil on the site would be used.

Power and Telephone Lines

The existing 13.2-kilovolt power line (maintained and operated by the Public Service Company of Colorado), which provides electric power to the South Platte intake (Map 1-2), would be extended 2.8 miles or 14,800 feet. The line would run to the Stevens Gulch area to meet power demands during construction. A telephone line would be extended by Mountain Bell along the same line and from the same point. This extended power line would consist of three conductors swung on treated poles with crossarms to form a T configuration. Conductors (wires) require about 25 poles per mile for support. The telephone line would be attached beneath the conductors on the same structures. The transformer to be positioned in the Stevens Gulch area would need to furnish about 2,000 kilowatts of power per hour during dam construction. Power and telephone extensions from an existing power line along Douglas County Road No. 5 to the east portal would require about 500 linear feet of new construction and would be of the same design and use as that for Stevens Gulch. Upon completion of construction, the power and telephone lines would be extended permanently about 1,300 feet to the dam and about the same distance to the west portal of the tunnel. About 100 kilowatts of power would be required to operate these proposed project components in the Platte Canyon after construction.

In order to supplement generated electric power for operation of the treatment plant, about 2,000 feet of three-phase, 12.6-kilovolt aerial power line would be extended from presently planned Intermountain REA overhead power lines along Douglas County Road No. 5 to the security fence surrounding the plant. Distribution lines from this point would be placed underground. Telephone service to the treatment plant would probably be tied into the existing Mountain Bell system presently serving the Roxborough Park area. Telephone lines would probably be attached to the same structure as the electric power lines, to the security fence surrounding the proposed plant. The telephone line from this point would also be placed underground. About 900 kilowatts of energy per hour would be required to operate the treatment plant and west portal facilities.

Construction of power and telephone lines would be accomplished by the power and telephone companies involved. Probable methods for constructing power and telephone lines in the Platte Canyon would include drilling and blasting pole holes. Treated wooden poles would be erected and outfitted with crossarms and insulators prior to swinging the conductors. Near the east portal truck-mounted drill rigs would probably drill the pole holes.

Tunnel

The proposed Foothills Tunnel, 17,967 feet long and 10.5 feet in diameter, would be capable of passing a maximum flow of 710 mgd.

The system would begin as concrete-lined tunnel, 1,705 feet long, from the bottom of the intake structure behind the diversion dam to the Stevens Gulch common portal where it would emerge for 170 feet as a conduit, buried except for vehicle access (Figure 1-9). From Stevens Gulch, a concrete-lined tunnel would extend about 16,092 feet to the east portal, located between Douglas County Road No. 7 and Little Willow Creek. A surge chamber would be located in the tunnel about 2,900 feet west of the east portal, vented by a 48-inch pipe which would extend 6 feet above ground.

The east end of the tunnel would be covered by a pressure-competent, reinforced concrete structure and would be housed in a 24 x 24 foot concrete maintenance and access building. A 10 x 12 foot door would provide vehicular access to the tunnel. Permanent power would be provided to both portals.

Construction of the proposed tunnel system would begin at the Stevens Gulch common portal and progress simultaneously in two directions: west toward the diversion dam and northeast toward the east portal. At the same time excavation at the east portal would be initiated, proceeding toward Stevens Gulch. Tunnel construction from Stevens Gulch probably would be performed initially by drilling and blasting of the tunnel headings. Blasting would take place once or twice a day, on a scheduled basis.

The material from the excavation of the proposed Foothills Tunnel at the common portal in Stevens Gulch would be deposited in a valley or draw approximately 400 feet from the portal along the road to the top of the dam. More material would probably be generated than could be stored at this site and would be hauled to another disposal site in the reservoir area.

All water discharged from the Stevens Gulch portal and east portal would be treated as required by a Colorado Department of Health discharge permit to make it acceptable for discharge into the South Platte River. As proposed by the DWB, the treatment of all tunnel waste water and disposal waste pile runoff would be the responsibility of the contractor after first obtaining a stream discharge permit. The treatment method would probably make use of the retention ponds described below.

Prior to actual tunnel excavation, approximately 3,000 cubic yards would be excavated to provide a vertical face for the tunnel headings at the east portal and at both portals in Stevens Gulch. In addition, approximately 5,000 cubic yards of material would be excavated in the Stevens Gulch portals for retention ponds and to provide level areas for the contractor's plant, offices, and equipment (Figure 1-9). At the east portal approximately 28,000 cubic yards of material would be excavated to construct retention ponds and water collection systems and to level areas for the contractor's plant, offices, and equipment (Figure 1-10).

The total tunnel project would entail the excavation of 102,000 cubic yards of in-place material that could possibly swell upon excavation and increase to a total waste volume of approximately 143,000 cubic yards. It is assumed that 40 percent of the material generated would be from the common portal at Stevens Gulch and 60 percent of the material generated would be at the east portal.

Most of the excavated material that would be generated from the tunnel operation at the east portal would be deposited in prescribed areas along Little Willow Creek (Figure 1-10). Prior to receiving the excavated materials these prescribed areas would be stripped of topsoil. The topsoil would then be stock-piled for eventual covering of the tunnel waste material. During the construction period, the toe of the slopes of the deposited material would have a cutoff trench to prevent any drainage from the excavated material entering Little Willow Creek. A portion of this material would be used to build the access road to the site of the proposed treatment plant.

Tunnel construction initiated from the east portal would also require drilling and blasting.

After excavation, the tunnels would be lined with steel reinforcement and conventionally placed concrete, averaging 8 inches in thickness. Concrete batch plants would be needed at either or both portal staging areas.

After construction, the structure in Stevens Gulch would be backfilled, covered with topsoil and seeded. The completed structure at the east portal would be shaped to original contour with material from the staging area excavation. The area would be landscaped and seeded.

After completion of the proposed Foothills Project, water would enter the tunnel at its western terminus directly below the intake structure behind Strontia Springs Dam. Selective draw-off from the reservoir would be made possible by the slide gates at various elevations on the intake tower. Trash racks would prevent large objects from entering the tunnel.

The water would flow through the tunnel, by gravity, to the treatment plant, protected by a surge chamber. This control chamber, or pocket, would prevent damage to the tunnel lining from a hydraulic surge, or water hammer, which is produced by changes in the rate of flow.

Maintenance crews could enter the structure at Stevens Gulch and the east portal with motorized vehicles via the service doors for routine inspections and for needed repair of the tunnel.

Treatment Plant Complex

Conduit No. 26, a buried pipeline 10.5 feet in diameter, would be connected to the east portal of the proposed Foothills Tunnel. The line would extend 1,721 feet in an easterly direction to the proposed treatment plant. The undercrossing at Little Willow Creek would be protected by a concrete saddle. In addition, one conduit of 54 inches and 60 inches diameter and 2,450 and 1,500 feet in length would connect to the Aurora Rampart Reservoir.

Access roads and 25 above ground and nine buried structures would occupy about 65 acres at the proposed 125 mgd treatment plant (Map 1-7). A septic tank and drainfield system would be constructed on the site for disposal of sanitary waste during plant operation. The plant would be designed to treat 125 mgd initially, but the design would facilitate expansion to a maximum capacity of 500 mgd. When the 500 mgd expansion of the Foothills plant is built, thirty-six above ground and fourteen buried structures would be added (Map 1-8).

During construction of the 125 mgd plant, heavy equipment would excavate for the structures that are to be buried and would grade the site. All of the excavated material would be employed; a portion of it would be used for fill or backfill, part for construction of earthen ponds, and part for access road construction. A 3,700-foot asphalt paved plant access road with a 24-foot roadway would provide permanent access to the site from the west, crossing Little Willow Creek north of the east portal. There would be disturbance to about six acres of land. A 2,600-foot crushed rock-surfaced road with a 28-foot roadway would provide access from Roxborough Road in the south. This would be used for construction activities.

A chainlink fence six feet high with three strands of barbed wire would enclose the treatment plant area. A remote control gate would be installed at the entrance to the plant.

In its approach to the proposed plant, the plant access road would divide into two roads. One would lead to the chemical building as well as to an employees' parking lot; the other would lead to a visitor parking area at the control building.

Preparation of footings would involve 5 to 40 feet of excavation so that foundations would rest on suitable material. Excavations for footings would be backfilled and compacted with granular material from on-site excavations.

Portions of all structures below finish grade would be constructed of poured-in-place concrete. Above-grade portions of structures would be constructed primarily of precast exposed aggregate panels, or poured-in-place, textured, colored concrete. Columns and frameworks for support of wall panels and roof systems would be of poured-in-place concrete or steel construction. Roof systems would be of precast concrete on steel frame and deck construction covered with rigid insulation and built-up roofing materials.

Except for the roads, the same design characteristics would apply to the 500 mgd expansion of the plant. The major facilities are summarized and described in Table 1-7.

The proposed 125 mgd construction operations would include site grading, excavation, trenching and backfilling, pouring of concrete, erection of buildings, and installation of equipment. Crawler tractors with rippers, compactors, scrapers, backhoes, and trucks would be required for this earthwork. Cranes, "cherry pickers", compressors, and trucks would also be used in the construction of the buildings and in the laying of underground pipe. This equipment would also be used for construction of the mechanical facilities for the plant. Trucks and other earthwork equipment would be used for the backfill and final landscaping. Temporary, portable sanitary facilities would be provided by the contractor on the construction site, to be serviced on a regular schedule by a reputable subcontractor.

The above discussion of operations will also apply to the 500 mgd expansion.

Landscaping of open spaces would involve reshaping disturbed areas, replacing topsoil and establishing vegetation to provide a natural appearance. The impacted land would total an estimated 80 acres at 125 mgd and 90 acres at 500 mgd. Landscaping and rehabilitation of the 125 mgd proposed treatment site would be based on the conceptual layout illustrated in Map 1-9 and Figure 1-11. Ultimately formal landscaping near buildings would be limited to approximately four acres and consist of lawn, trees and ornamental shrubs, with a fixed irrigation system.

The treatment plant complex would rely entirely on gravity-fed water flows, as diagrammed in Figure 1-12. If an emergency required rapid closing of the plant's influent valves, excess flow, caused by the slow closing of the energy dissipation valves, would be allowed to overflow from the headworks structure to an on-site holding pond. From the holding pond, the excess flow that is being stored would be discharged to the drainage and low retention pond at about 35 cubic feet per second (cfs). Maximum flow from the raw water conduit would be 1,160 cfs.

A hydroturbine installed in the headworks structure between Conduit No. 26 and the treatment plant would help dissipate energy from water flowing through the tunnel and would produce electricity for operation of the plant. The generator for the 125-mgd treatment facility should produce power in the range of 1,050-1,600 kilowatts per hour at 125 mgd and 2,200-4,700 kilowatts at 500 mgd, depending upon flow through the filter plant. Using the mean production per hour of 1,325 kilowatts at 125 mgd, 3,262 kilowatts at 500 mgd, 24 hours per day, 365 days per

TABLE 1-7

SUMMARY OF PROPOSED TREATMENT PLANT FACILITIES

Facility	Primary Functions	Basic Features	Comments
Headworks structure	Generate power and dissipate energy	One hydroturbine with parallel energy dissipating valves for occasional by-passing at 125, a second hydroturbine at 500 mgd	Poured-in-place and precast concrete construction; exposed
Chemical building	Store and feed chemicals	Storage and feed facilities for all chemicals except storage of chlorine and ammonia	Poured-in-place and precast concrete construction, steel framework; exposed
Flocculation and sedimentation basins	Flocculate or draw solid particles together and settle suspended solids in the water	Four parallel basins at 125 mgd, 12 additional parallel basins at 500 mgd	Poured-in-lace and precast concrete construction; buried except for equipment and gate house
Filter Complex	Filter the water	Eight parallel filters at 125 mgd, 24 additional parallel filters at 500 mgd	Poured-in-place and precast concrete construction; exposed
Clearwater reservoirs (two)	Store treated water	Two 25-million-gallon reservoirs at 125 mgd, 2 additional 25-million-gallon reservoirs at 500 mgd	Poured-in-place concrete construction; buried

TABLE 1-7 (cont.)

SUMMARY OF PROPOSED TREATMENT PLANT FACILITIES

Facility	Primary Functions	Basic Features	Comments
Backwash water reservoirs (two)	Store water for backwashing or cleaning filters by running water back through the system	Two 500,000-gallon reservoirs with common well construction	Poured-in-place concrete construction; buried
Waste water recovery facilities	Recover and recycle waste water primarily from filter backwashing	Two 2-million-gallon concrete-lined basins and recycle pump stations	Primarily poured-in-place concrete construction; exposed
Waste disposal facilities	Dispose of waste waters and waste solids	Solids spray application pump station	Poured-in-place and precast concrete construction; exposed
		-Six sand-bottomed solid drying ponds at 125 mgd, 12 additional drying ponds at 500 mgd -Three 0.75-million-gallon waste water retention ponds -One 12-million-gallon overflow holding pond	Earthen construction, 33 percent slope on embankments; exposed
		Septic tanks and drainfields for sanitary wastes	Buried
Chlorine and ammonia storage facilities	Bulk storage of chlorine and ammonia	Enclosed storage area for chlorine, exterior steel tanks for ammonia	Poured-in-place and precast concrete construction; exposed
Control building	Centralized control of plant processes, operators' facilities, visitors' center	Two-level building	Poured-in-place and precast concrete construction with steel framework; exposed

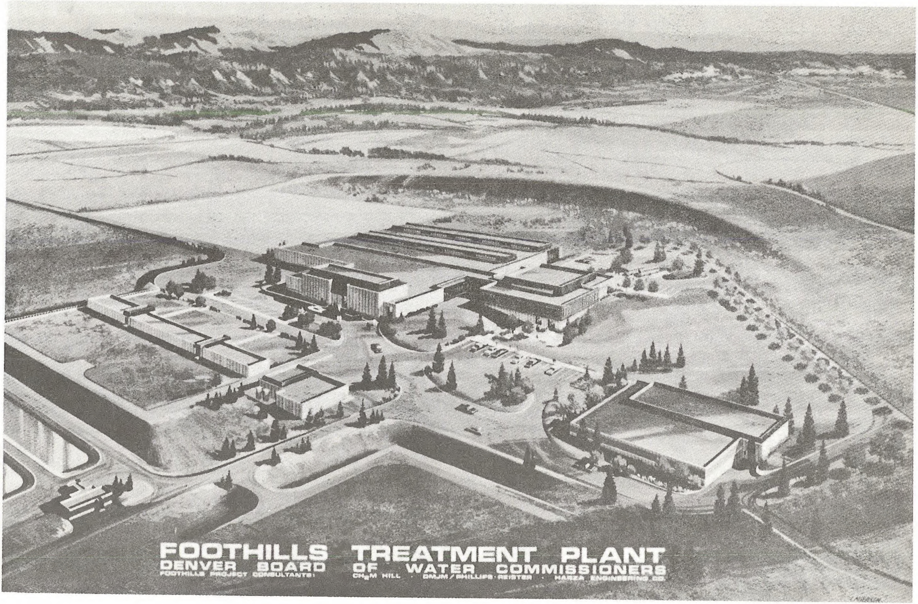
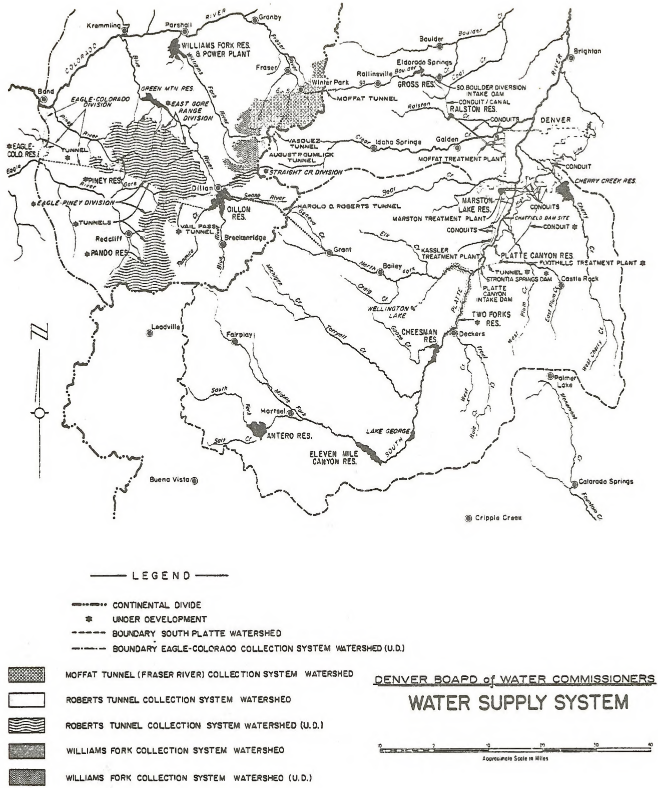

FOOTHILLS TREATMENT PLANT
DENVER BOARD OF WATER COMMISSIONERS
FOOTHILLS PROJECT CONSULTANTS: CH2M HILL · DMJM/PHILLIPS·REISTER · HARZA ENGINEERING CO.

FIGURE I-11



MAP 1-10

Source: DWB, 1973

CHAPTER 2

DESCRIPTION OF THE PRESENT ENVIRONMENT

PRESENT ENVIRONMENT

The description of the environment is organized into categories which relate to all classes of land ownership. The aspects of the environment which are described in each category are most likely to be affected by the proposed Foothills Project. The degree of detail used in the description is related directly to the degree of anticipated impacts.

The area that would be affected by the Foothills Project is generally in metropolitan Denver. It includes a linear area extending from Highlands Reservoir in Littleton southwesterly to the proposed treatment plant site near Roxborough Park, the South Platte Canyon from Chatfield Reservoir to South Platte, and the North Fork of the South Platte River, Dillon Reservoir, the Blue River, and the South Platte River below Denver are affected to a much lesser degree.

SOCIO-ECONOMIC CONDITIONS

Human Populations

The socio-economic environment related to the Foothills Project centers around the Denver metropolitan area and consists of six counties: Adams, Arapahoe, Boulder, Denver, Douglas, and Jefferson. The Denver metropolitan area is the largest in the Rocky Mountain states. The median population in 1970 for the six Denver area counties was 173,965, ranging from 8,407 in Douglas County to 514,678 in Denver County. The total population of the six counties was 1,235,936 (U.S. Bureau of the Census 1973).

In 1975, the estimated median population for the six counties was 213,000, a median increase of 42,150 (27.9 percent). The range decreased because Denver lost population at the top of the range and Douglas at the low end gained. The estimated 1975 range was 15,700 in Douglas County to 489,000 in Denver County. Total population for the six counties in 1975 was estimated at 1,402,500 (U.S. Bureau of the Census from U.S. Highway 85 to the site of the proposed treatment plant and east tunnel portal. In the rolling plains between Roxborough Park and the Denver metropolitan area, access is generally limited to existing roads, although the gentle terrain does not preclude cross-country travel.

Although much of the country along the alignment of proposed Conduit No. 27 and the second parallel conduit is undeveloped, the Roxborough Park road, Aurora filtration plant road, Titan Road, U.S. Highway 85, and the Highlands Ranch road provide access to the alignment at roughly 1 1/2 mile intervals between the proposed treatment plant site and Highlands Reservoir. At Highlands Reservoir, paved County Line Road links transportation from U.S. Highway 85 to city streets extending southward from the Denver metropolitan area. These public roads and streets provide access to or along the proposed conduit alignment between Highlands and Hillcrest Reservoirs. The preliminary annual average daily traffic volumes for 1975 are shown in Table 2-29 (Colorado Division of Highways Traffic Investigations Section).

Other transportation modes in the area include two railroads which parallel U.S. Highway 85 - the Denver and Rio Grande Western and the Atchison, Topeka and Santa Fe. Both have commercial siding tracks at Louviers.

Stapleton International Airport, 25 miles northeast of the project area, is the nearest large-scale commercial air service. Arapahoe County Airport, 9 miles east of the project area, accommodates local non-commercial service. A short landing strip near Louviers, in Douglas County, handles small, local aircraft use.

FUTURE ENVIRONMENT WITHOUT THE PROPOSED ACTION

INTRODUCTION

The Description of the Future Environment without the proposed Foothills Project is based on several important assumptions derived largely from historical data and trends, which follow.

1. The total amount of raw water reliably available to the DWB from its collection, storage, and diversion systems will remain at 312,300 acre-feet annually. No additional raw water will become available.

2. Human population in the DWB service area will continue to grow as estimated by the Denver Regional Council of Governments (DRCOG). The advisory group for the Foothills Project for socio-economic

discussion including representatives of the Colorado Division of Planning, HUD, EPA, BR, BLM, and DRCOG chose to use population projections of DRCOG (Table 1-4).

3. As long as raw water is available the current trends in water use patterns will continue. This will be indicative of commerical, industrial, fire protection, governmental user, and operating losses needs that will accompany the projected growth in population. Such trends will be reflected in both the average per capita per day consumption and in the maximum-day per capita consumption.

4. All discussion in this section will be directed to conditions in the year 2001.

The future environment as described is based upon the conditions that are predicted to occur in the foreseeable future. The predictions in turn are based largely on projected population growth for the DWB service area as shown in Table 1-4.

SOCIO-ECONOMIC IMPLICATIONS

The DWB's capability to treat raw water would be limited to a rate of 520 mgd. In order to insure that the DWB system treatment and transmission capacity is not overtaxed, water-use restrictions beginning early in spring and continuing through fall would be implemented. These restrictions would become more severe with each succeeding year, as the population continues to increase.

Review of Table 1-4 indicates that DWB's present reliable annual raw water supply (312,300 acre-feet) would become inadequate to meet annual demand between 1985 and 1990. If no additional treatment capacity is developed and water-use restrictions are implemented, the reliable annual raw water supply would be fully utilized in 1990. This is indicated by the data presented in Table 2-30. Before 1990, the DWB's ability to deliver treated water during peak-use periods of the year would be limited by available treatment capacity. Beginning in 1990, the DWB's ability to provide treated water would be limited both by treatment capacity and available raw water.

Since water shortages would be inevitable in view of current levels of use during peak-use periods, the greatest restriction that could be imposed would be to limit per capita use to winter months' rates. At the current average winter-use rate (117 gallons per day per capita), the projected reliable annual water supply available for treated water service in the year 2001 (291,356 acre-feet) would serve a population of about 2,200,000.

TABLE 2-30

PROJECTED WATER SHORTAGES WITHOUT THE PROJECT AND WITH A LIMITED WATER SUPPLY

Year	Annual 1/ Treated Water Required (ac-ft) 4/	Raw Water 1/ Diversions to Other Uses (ac-ft) 4/	Total 1/ Annual Raw Water Required (ac-ft) 4/	Treated 2/ Water Used (ac-ft) 4/	Raw 3/ Water Used (ac-ft) 4/	Total Raw Water Used (ac-ft) 4/	Raw and Treated Water Shortage (ac-ft) 4/	Treated Water Annual Per Capita Per Day Use (gdc) 5/
1975				207,982	27,883	235,865		208
1980	242,977	24,922	267,899	242,658	24,922	267,580	319	226
1985	269,710	26,243	295,953	265,001	26,243	291,244	4,709	224
1990	298,331	26,238	324,569	286,115	26,185	312,300	12,269	220
2000	371,509	27,023	398,532	288,526	23,774	312,300	86,232	180
2001	378,530	27,210	405,740	288,651	23,649	312,300	93,440	176
2010	441,719	28,962	470,681	288,699	23,601	312,300	158,381	152

1/ From Table I-2.
2/ Reflects treated water used after imposing use restrictions during peak-use period of the year.
3/ Additional shortages imposed beginning in 1990 due to inadequate raw water supply.
4/ Acre-feet.
5/ Gallons per day per capita.

Some of the adjustments that would be made are already in progress (spring 1977, a drought year). The adjustments are occurring outside-the-residence, principally in horticultural irrigation. If necessary, these adjustments will continue until average per capita consumption historically characteristic of winter months occur throughout the year. It is possible for this to happen with little or no change in within-the-residence or nonresidential consumption rates. As shown in Table 2-4, nearly 40 percent of the residential treated water supply for a family of four in the Denver area is used for horticultural irrigation, which amounts to 19 percent of all water used in the DWB system.

WATER RESOURCES

As population grows within the DWB service area, the demand for water will also increase assuming per capita consumption consistent with current trends. With population growth, water demand will increase until it equals the reliable available raw water supply, 312,300 acre-feet.

Using the ten-year period 1964-73 to depict the DWB water supply operation it was determined that an annual average of 189,600 acre-feet of water was treated or delivered to raw water users after operating losses. Of this amount, 126,900 acre-feet was provided by the South Platte and Roberts Tunnel systems. According to DWB estimates, reliable supply from the South Platte and Roberts Tunnel systems after losses is 206,000 acre-feet. Therefore, the unused portion of the South Platte and Roberts Tunnel systems' reliable raw water supply during the ten-year period after losses averaged 79,100 acre-feet. This water is available from Dillon Reservoir and will be included as part of reliable water supply in discussion.

Diversions from Dillon Reservoir will vary with the availability of water originating in the South Platte River watershed that are divertible by the DWB. When streamflow conditions in the South Platte River are good, the DWB will utilize within its water rights more South Platte River water and reduce its demands on the Roberts Tunnel System. Conversely, when streamflow conditions in the South Platte River are deficient, the DWB will draw more water from the Roberts Tunnel system.

Without the proposed action, the DWB would continue to divert raw water for treatment at the Kassler and Marston plants from the South Platte River at the Platte Canyon Intake Dam and Highline Diversion Dam at rates ranging up to about 400 cfs. Diversions at this rate would normally occur during the peak water-use period of the year, generally July and August. In rare situations, all of the 400 cfs could be released from the Roberts Tunnel; however, this would not occur unless there were a complete lack of South Platte River water available for DWB's direct diversion under its water rights and a concurrent lack of South Platte River storage water (or physical constraints impeding the use of stored water) from South Platte Reservoirs. Average annual flows in the DWB system would continue to increase until about 1990, when the amount of reliable raw water presently available to the system would be fully utilized. Without additional raw water supplies, average annual flows would not increase after 1990. Projected average annual flows at a number of locations in the South Platte River watershed are shown in Table 2-31.

Table 2-32 presents the projected monthly average discharge without the Foothills Project at several locations within the South Platte River watershed including Roberts Tunnel imports. These flows are based on a number of assumptions.

1. Full utilization of the South Platte and Roberts Tunnel Systems reliable water supply is superimposed upon the average streamflow and diversions as reflected by the ten-year period, 1964-73.

2. Average monthly streamflow of the South Platte River at Waterton is representative of the flow anticipated after full use of the reliable water supply from the South Platte and Roberts Tunnel Systems in the event of the recurrence of a similar ten-year period.

3. Diversions in the reach of the South Platte River between South Platte and Waterton for purposes other than water treatment would remain the same as the average for 1964-73.

298,000 acre-feet	- South Platte River at South Platte
-148,400	- South Platte River at Waterton
149,600	
-117,700	- DWB - South Platte River and Roberts Tunnel Water Treated (DWB 1964-73)
31,900	- Historical Diversion

4. Moffat Treatment Plant would operate for a six-month period, April through September.

5. These discharge values are not absolute due to vagaries of climatic, hydrologic, and demand conditions from year to year.

Channel stabilization work completed in the upper 12.8-mile reach of the North Fork South Platte River can accommodate sustained flows up to 680 cfs. Projected average monthly discharges on the North Fork South Platte River at Grant without the proposed action are within that level.

TABLE 2-31

PROJECTED AVERAGE ANNUAL FLOW AT KEY GAGING STATIONS WITHOUT THE FOOTHILLS PROJECT

Gaging Station	Historical 10-year Average Flow (1964-1973)		Projected Discharge 1990	
	cfs	ac-ft	cfs	ac-ft
South Platte River below Cheesman Dam	177	128,200	177	128,200
North Fork of the South Platte River below Grant 1/	68	49,400	-	-
North Fork of the South Platte River at South Platte 1/	157	113,900	-	-
Roberts Tunnel Imports	41	29,600	156	112,900
North Fork of the South Platte below Grant with Roberts Tunnel	109	79,000	224	162,300
North Fork of the South Platte at South Platte With Roberts Tunnel 2/	198	143,500	307	222,600
South Platte River at South Platte with Roberts Tunnel 2/	412	298,000	521	377,100
South Platte River below Denver 3/	649	469,500	711	514,600

1/ Flows of the North Fork of the South Platte River at Grant and at South Platte not including historical Roberts Tunnel diversions.

2/ Flows reflect assessed losses of 5 percent on Roberts Tunnel diversions.

3/ Includes the sum of South Platte River at 19th St. gage plus estimated sewage return (57% of additional Roberts Tunnel import) and recorded discharge of Clear Creek at mouth.

4/ 2001 projected flows would be the same, assuming no raw water increase.

TABLE 2-32

PROJECTED MONTHLY AVERAGE DISCHARGE OF THE NORTH FORK SOUTH PLATTE RIVER AT GRANT AND SOUTH PLATTE, AND SOUTH PLATTE RIVER AT SOUTH PLATTE WITHOUT THE FOOTHILLS PROJECT (INCLUDING ROBERTS TUNNEL IMPORTS) (in cfs)

	Roberts Tunnel Imports		North Fork South Platte River at Grant		North Fork South Platte River at South Platte		South Platte River at South Platte	
Month	Historic 1/ Discharge	1990 2/ Projected Discharge	Historic 1/ Discharge	1990 Projected Discharge	Historic 1/ Discharge	1990 Projected 3/ Discharge	Historic 1/ Discharge	1990 Projected 3/ Discharge
January	22	152	30	169	67	191	134	158
February	17	148	32	163	58	182	123	247
March	20	145	38	163	69	188	149	268
April	37	189	63	215	127	272	332	477
May	26	179	148	301	375	520	900	1045
June	14	30	255	271	490	505	910	925
July	74	90	230	246	362	377	762	777
August	141	199	226	284	348	403	664	719
September	66	218	113	265	182	326	377	521
October	27	208	65	246	123	295	238	410
November	19	159	48	188	93	226	184	317
December	24	152	46	174	73	195	143	265
Average Annual	41	156	109	224	198	307	412	521
Acre-feet	29,600	112,900	79,000	162,300	143,500	222,600	298,000	377,100

1/ Historic discharges are ten year (10) averages for the period 1964-1973.

2/ Based on population projections and historical use patterns, the 112,900 acre-feet raw water available in Dillon Reservoir would be in use by 1990.

3/ The future imports have been reduced by 5% loss at South Platte stations.

TABLE 2-33

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Socio-Economic Conditions	1. Human populations: 1,402,500 (1975) (DRCOG)	1. Human populations: 1,693,700 (2010) (DRCOG estimate)
	2. Employment and Manpower: 6.5% unemployment (3/1977); 725,600 labor force (3/1977).	2. Industry is #3 on priority list of water (after 1. domestic, 2. agricultural); industries dependent on DWB for daily service would layoff in water shortage periods.
	3. Housing: 563,837 dwelling units (4/1976).	3.
	4. Municipal and Industrial Water Systems:	4. Municipal and Industrial Water Systems: current use trends would continue as long as raw water is available; supply will remain 312,300 ac-ft annually.
	a. DWB treated water capacity 520 mgd (1977).	a. Treated water to DWB's service area would be limited to maximum day rate of 520 mgd; without additional raw water, supply would become inadequate between 1985-1990; (19% reduction in per capita use before 1990).
	b. Annual use of treated water 181 mgd (1971-75); maximum single day use 480 mgd average.	b.
	c. Treated water storage capacity (DWB system) 287.8 million gal (1975).	c.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Socio-Economic Conditions (cont.)	d. Consumption rates of treated water (DWB service area) range 117 gdc (January) to 370 gdc (July) (1975); maximum single day is 608 gal (1973).	d.
	e. Irrigation uses 40% domestic use.	e.
	5. Law Enforcement: 47.6% of 6-county police in city and county of Denver.	5.
	6. Fire Protection:	6.
	a. 22 fire departments; 1,919 personnel; 209 pieces of equipment in 87 stations.	a.
	b. Town Index (Colorado-Wyoming) rating gave Denver "two" rating (very high); median for counties was "seven".	b.
	7. Community Attitudes: expression emanates from informed minorities.	7.
	a. Growth advocates who see plentiful water necessary;	a.
	b. Restricted growth factions;	b.
	c. Environmentalists;	c.
	d. Sectional differences between east/west slope;	d.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Socio-Economic Conditions (cont.)	e. One survey indicates receptivity to water conservation (1973).	e. Water rationing or conservation would be essential to maintain community services.
	8. Life Styles:	8. Life Styles:
	a. 10% of Denver area population below poverty level; average income for family of four is $21,092.	a.
	b. Domestic horticulture extensive.	b. Cut back horticulture irrigation.
Water Resources	1. Water rights: Under Colorado law, DWB has right to supply raw water to these treatment plants: Kassler (50 mgd), Marston (260 mgd), Moffat (210 mgd), and raw water users.	1. Water rights: the total amount of raw water available to DWB will remain at 312,300 ac-ft annually. Without additional raw water, this supply would become inadequate between 1985-1990.
	2. Flows and Reservoir Levels:	2. Flows and Reservoir Levels: average annual flows would increase until 1990 when raw water would be fully utilized. Channelization can accommodate up to 680 cfs.
	a. 1964-73 raw water 205,300 ac-ft per year average; 170,400 ac-ft treated per year average.	a.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Water Resources (cont.)	b. Moffat System: Williams Fork River, Fraser River, South Boulder and Ralston Creeks, to Moffat Treatment Plant 58,500 ac-ft (1975).	b.
	c. Roberts Tunnel System: Dillon Dam and Reservoir (254,036 ac-ft capacity) and Roberts Tunnel (1,000 cfs maximum capacity (1977)); inflow to Dillon average 187,500 ac-ft per year; 29,600 ac-ft average annual release Roberts Tunnel (1964-73).	c.
	d. South Platte System: average annual runoff (1964-73), 266,100 ac-ft; dependent on natural runoff, releases of stored water, and trans-mountain diversions; lowest average monthly flow in February, highest in June.	d.
	e. North Fork of the South Platte: dependent on natural runoff and Roberts Tunnel diversion from Dillon; channelization between east portal of Roberts Tunnel and Bailey, Colorado provides for sustaining flows of 680 cfs, and peak discharge of 1,020 cfs.	e.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Water Resources (cont.)	f. Miscellaneous Minor Waters	f.
	1. Willow Creek, Bear Creek, Stevens Gulch, unquantifiable discharges;	1.
	2. Plum Creek - 154,000 cfs maximum instantaneous flow (1965);	2.
	3. Spring Gulch, Marcy Gulch, Dad Clark Gulch, Willow Creek - unquantifiable drainages.	3.
	3. Ground Water:	3.
	a. Fissures pass water	a.
	b. Pierre formation is poor aquifer	b.
	4. Water Quality:	4.
	a. Physical, chemical, bacteriological data tabularized;	a.
	b. Public Health Standards tabularized.	b.
	c. CDW classes South Platte River as B-1 cold water fishery stream (1977).	c.
	d. Salinity of Colorado River at Cameo, Colorado is 440 mg/1, and at Imperial Dam, Arizona is 861 mg/1.	d.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Aquatic Resources	1. Fish populations: Special extent and distribution tabularized in South Platte River, Waterton Canyon, North Fork of the South Platte, Dillon Reservoir.	1. Fish populations: 60% reduction.
	2. Bottom Fauna: sampling data in text.	2. Bottom Fauna: 95% reduction.
	3. Aquatic Vegetation: none	3. Aquatic Vegetation: less in reservoir from drawdown.
	4. Amphibians: species data tabularized.	4. Fewer amphibians.
Geology, Minerals, and Topography	1. Topography and General Geology 2 provinces: southern Rocky Mountain and Great Plains.	1. Topography and General Geology: very little change except normal weathering modifications.
	2. Geologic Processes: sedimentation.	2.
	3. Minerals:	3. Minerals: USGS (1963) infers uranium and pegmatite minerals may be present in minable quantities.
	a. Radium, radon, uranium.	a.
	b. Limestone, clay.	b.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Geology, Minerals, and Topography (cont.)	4. Geologic Hazards and Problem Areas	4.
	a. Faults, joints, seismic activity, earthquake hazard discussed, not quantifiable.	a.
	b. Slides and rock falls discussed in text; hazard not quantifiable.	b.
Soils	1. Soil descriptions are mapped from 3 SCS soil surveys.	1. Soil development, erosion, and deposition would continue as at present; urban expansion in the flat area would decrease productive potential; erosion would increase in the canyon from increased flows and increased recreation.
	2. Soil descriptions and interpretations and specific soil properties tabularized.	2.
	3. Sediment Yields: 1974 - low yield 0.1-0.2 ac-ft per 640 acres per year (1/2 ton/ac/yr.) undisturbed; Disturbed - high yield - 1.0 ac-ft per 640 acres per year (3 tons/ac/yr.)	3.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element		Existing Environment (year 1977)		Future Environment (year 2010) Without the Proposed Action 1/
Terrestrial Resources	1.	Vegetation (1977): 3 vegetative zones, 4 basic plant communities, mapped in text and extent tabularized.	1.	Vegetation: increased flows in North Fork of the South Platte River and South Platte would cause unquantifiable temporary destruction of riparian vegetation (and loss of wildlife habitat); however it would be re-established.
	2.	Summary of vegetation and wildlife	2.	Recreation pressure would decrease wildlife in the canyon. If sheep were replaced, the range can support 76 head.
		a. Bighorn sheep mapped		a.
		b. Endangered species		b.
		c. Peregrine falcon		c.
		d. Other animal species.		d.
Climate and Air Quality	1.	Temperature - relation to altitude; average 45-50^{o} F, extremes of -35 to -40^{o}F in winter to 100^{o}F summer.	1.	
	2.	Precipitation: May highest month (2.75"); average annual precipitation 16".	2.	

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Climate and Air Quality (cont.)	3. Ambient Moisture and Evaporation: Ambient levels low, 15-24" per year pan evaporation.	3.
	4. Winds: no data in area; Denver prevailing wind south, 9.3 mph.	4.
	5. Air Pollution: no data, but total suspended particulates occasionally exceeded by fugitive dust.	5. Air pollution would increase with urbanization but the Air Quality Maintenance Plan (EPA 1974), would reduce carbon monoxide by 1981 and vehicular hydrocarbons by 1983. Nitrogen oxide would be acceptable at both years 1977 and 2010.
Noise	32-40 dBA low noise level.	Noise levels would remain the same.
Visual Resources	Visual elements discussed, rated, mapped and pictured.	Increased recreational use, channelization of the North Fork and additional developments would reduce visual integrity.
Cultural Resources Archaeological Resources	Archaeological potential discussed from data available for 1977.	Archaeological resources would evidence collecting and digging, as well as destruction through urban expansion.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Historical Resources	Historical sites tabularized; 106 protection listed; North Fork of South Platte Historic District is on National Register.	Deansbury Station and Strontia Springs sites should remain the same; railroad grades, cuts, and rockwork should remain the same.
Paleontological Resources	Two localities reported nearby study area, plus mammoth skull at Chatfield Dam and Paleocene deposits of vertebrates are considered likely.	The paleontological potential would remain the same.
Recreation	Type and extent of recreation utilized discussed and tabularized for:	
	1. Water Canyon (10,000 visits in 1976)	1. Waterton Canyon visitor pressure would increase; quality would depend on recreation management; Roxborough Park will expand 756 acres for 1,000 recreationists per day.
	2. South Platte river to Cheesman Reservoir	2. South Platte River to Cheesman Reservoir visits would double by 2010; USFS South Platte Planning Unit will be ready in 1980; USFS will expand recreation from 1980-2010;
	3. North Fork of the South Platte	3. High flows will limit recreation in North Fork of the South Platte;

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

TABLE 2-33 (cont.)

SUMMARY OF EXISTING AND FUTURE ENVIRONMENT

Environmental Element	Existing Environment (year 1977)	Future Environment (year 2010) Without the Proposed Action 1/
Recreation (cont.)	4. Treatment Plant Site	4. Chatfield Dam (1974) and reservoir will produce 1,300 surface acres of water recreation.
Land Use	1. Waterton Canyon - 1/3 DWB-owned; 2/3 public land (USFS/BLM)	1. Land use patterns will be similar to the present; patterns will be established by topographic features (Waterton Canyon), man-made feature (Chatfield Dam and Reservoir) and land use trends to intensive residential development (see maps).
	2. Denver expanding metro area	2. Utilities and roads would be upgraded by 73 acres annual aereal development near the conduits and 0.1 miles annually north-to-south.
	3. Small rural communities	3.
	4. Large and grazing holdings	4.
	5. Chatfield Dam (1975)	5.
	6. Discussion of raods (traffic volume tabularized)	6.
	7. Air traffic	7.

1/ Where there are blank spaces, no projection was possible for the corresponding aspect of the existing environment.

CHAPTER 3

ENVIRONMENTAL IMPACTS OF THE PROPOSAL

This chapter identifies and analyzes impacts of the proposed Foothills Project. Each impact is analyzed in a cause and effect manner; secondary impacts are identified and traced as far as practical.

The cause identified is tied to a component of the project proposal (Chapter 1) and the effect identified is tied to a component of the environment (Chapter 2). Existing environmental data were used to assess temporary or shortterm impacts, while both existing and projected future environmental data were used to assess permanent or longterm impacts.

ASSUMPTIONS AND ANALYSIS GUIDELINES

Impacts on the environment if the proposal is implemented will be analyzed using the following assumptions:

1. Impacts will be analyzed considering two levels of operation of the Foothills Treatment Plant: 125 mgd (million gallons per day) and 500 mgd.
2. Implementation will be 3 years from the granting of the rights-of-way permit for the 125 mgd plant, assumed here to be May of 1978; measuring impacts at this level of operation will begin then. It is assumed that expansion to 500 mgd will begin before 2001, since the 500 mgd will be required at that time, based on current population and use trends. Cumulative impacts for expansion to 500 mgd will be measured at the year 2001.
3. All project components will be assumed to last as long as the project is operational, here estimated at 75 years.
4. There will be no additional raw water supplies required for operation at the 125 mgd level before 1988. Additional raw water supplies must be available at that time in order to satisfy the projected treated water demand associated with the projected population and current water use trends.
5. In order to consider maximum impacts, the impact of providing additional raw water supplies will be considered at the maximum level of implementation, 500 mgd.
6. Obtaining additional raw water will, at some point, involve changes in the flows within sections of the South Platte River watershed. In Chapter 3, analysis of the impacts of

obtaining more raw water will begin at the highest upstream point on the South Platte River and its affected tributaries. Chapter 8, Alternatives, will contain a general analysis of impacts related to the development and operation of various facilities required to increase the DWB raw water supplies.

7. The assumed population growth during the period of the project will be based on projections of the Denver Regional Council of Governments (DRCOG) as shown in Table 14.

8. Any impacts over 30 years will be considered permanent.

9. The following data concerning individual project elements have been abstracted from the detailed description of the proposal and are assumed to be accurate data for impact analysis:

Project Elements	125 mgd development	500 mgd development
DAM		
Height, above stream bed	243 feet	N/A
Crest Elevation	6,002 feet	N/A
Crest Length	601 feet	N/A
Thickness	31 feet at base 10 feet wide at crest	N/A
Excavation	130,000 cubic yards	N/A
INTAKE TOWERS		
Denver Intake	A hexagonal structure 35 feet thick at the base and 179 feet tall.	N/A
Aurora Intake	A square structure 21 feet thick at the base and 123 feet tall.	N/A
RESERVOIR		
Normal Capacity	7,700 acre-feet at 6,002 foot elevation.	N/A
Silt-storage Capacity	2,110 acre-feet (75 years)	N/A
Surface Area	98 acres at 6,002 foot elevation.	N/A
Pool Length	1.7 miles at 6,002 foot elevation.	N/A
TUNNEL		
Length	17,967 feet in 3 segments 1,705 feet of 10.5-foot diameter concrete-lined tunnel from intake tower to Stevens Gulch. 170 feet of 10.5-foot diameter conduit in Stevens Gulch. 17,092 feet 10.5-foot diameter concrete-lined tunnel to the east portal.	N/A

Project Elements	125 mgd development	500 mgd development
Excavation	143,000 cubic yards 40% from Stevens Gulch 60% from East Portal	N/A
Aggregate Needs	53,000 cubic yards	N/A
TREATMENT PLANT COMPLEX		
Conduit 26 length	1,721 feet of buried 10.5-foot diameter pipe from east portal to the treatment plant.	N/A
Power generation (hydroturbine capacity)	11 million kilowatt-hours annually	78 million kwh annually
Aurora Intertie System	2 segments: 2,450 feet of 54-inch buried conduit 1,500 feet of 60-inch buried conduit	N/A
Treatment Capacity	125 mgd	375 mgd
Plant Structures	25 aboveground improvements	36 aboveground improvements
	9 underground structures	14 underground structures
	65 acres occupied by structures	49 acres occupied by structures
Sludge Production	Averages 4,490 pounds/day	Averages 28,500 pounds/day
Internal access	Asphalt surfaced road 3,700 feet long; Graveled road 2,600 feet long (temporary)	N/A
CONDUIT NO. 27		
Length	53,800 feet of 108-inch buried steel or concrete cylinder from treatment plant to Highland Reservoir. 33,000 feet of 90-inch conduit from Highland Reservoir to Hillcrest Reservoir.	53,800 feet of 108-inch buried steel or concrete cylinder from treatment plant to Highland Reservoir. 33,000 feet of 90-inch conduit from Highland Reservoir to Hillcrest Reservoir.

Project Elements	125 mgd development	500 mgd development
Rights-of-way	60,800 feet at 100 feet wide or 140 acres. 10,000 feet at 80 feet wide or 19 acres. 16,000 feet; street right-of-way.	same right-of-way as 125 mgd same right-of-way as 125 mgd same street right-of-way as 125 mgd
Access	Temporary road paralleling conduit	Temporary road paralleling conduit
ACCESS ROADS AND STAGING AREAS		
Road Improvements	20,400 feet of 22' wide gravel surface. 6,400 feet of 13' wide graded surface with turnouts.	N/A N/A
POWER AND TELEPHONE LINES		
Dam and Stevens Gulch portal	13.2 kilovolt overhead lines, 2.8 miles with telephone lines on same poles.	N/A
Treatment Plant and East Portal	12.6 kilovolt overhead line, 2,500 feet with telephone lines on same poles.	N/A
MANPOWER DATA		
Construction	Average of 400 persons per year working three eight-hour shifts seven days a week for three years.	Average of 27 persons per year work three eight-hour shifts seven days a week for seven years.
Operation and Maintenance	25 workers for the life of the project - 75 years.	10 additional workers for the life of the project - 75 years.

TABLE 3-16

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Socio-Economic Conditions	1. Employment and Manpower: an average of 400 people employed per year reducing unemployment of Denver area construction workers by 12.3% during construction period (3 years); 25 workers for operation and maintenance - for 75 years - life of project.	1. Employment and Manpower: expanding plant to 500 mgd, employment would average 27 workers per construction year, reducing unemployment among construction workers by 0.7% over 7-year construction period; 10 additional people needed for operation and maintenance for the life of the project.
	2. Accidents: 43 accidents/3 year construction period; 20 accidents for vehicles 75-year operating life; 16 accidents hauling trucks.	2. Accidents: with expansion to 500 mgd, an additional 35 construction accidents and 53 accidents with trucks.
	3. Income: 125 mgd would add 0.6% to Denver gross domestic product; 400 families and/or individuals would increase income in construction phase.	3. Income: 500 would add less than 0.6%; 192 families and/or individuals would increase income (all increments).
	4. Municipal and Industrial Water Systems:	4. Municipal and Industrial Water Systems:
	a. 125 mgd can meet maximum-day demands through 1988, consuming 286,883 ac-ft annually.	a. Additional treatment capacity beyond 125 mgd would be required in 1988 and also additional raw water supplies - 378,530 ac-ft, if no water conservation imposed, by year 2001.
	5. Community Lifestyles: lifestyles could remain unchanged until 1988.	5. Community Lifestyles: lifestyles could remain unchanged until 2001.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Water Resources	1. Surface water: if flows would exceed 4,400 cfs during construction of the dam, an additional 8,040 tons (4 ac-ft) of sediment would be deposited along the South Platte River, an increase of 11.5% over average annual sediment load.	1.
	2. Raw water supply of 79,100 ac-ft presently unused would be utilized in 1988.	2. Additional raw water would be required:
	a. Colorado River Watershed: surface water impacts would be same with or without the proposed action (see No Action, Chapter 8)	a. Colorado River Watershed: raw water sources would be needed and are arrayed in Chapter 8.
	b. South Platte River System: DWB's ability to divert raw water instantaneously would increase from 400 cfs to 595 cfs. Diversion from various points would vary.	b. South Platte River System: A maximum instantaneous demand for raw water would increase up to 775 cfs, 580 more than maximum for plant operating 125 mgd, resulting in greater velocity and increased depth. Maximum diversion requirement of 1,175 cfs if Marston and Kassler are also operating at capacity in peak-use periods.
	3. Water Quality:	3. Water Quality:
	a. Sedimentation: 0.04 ac-ft (75 tons) additional into South Platte annually. Inflow quality would determine water quality; turbidity is unquantifiable but would be reduced.	a. Presented in Chapter 8

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Water Resources (cont.)	b.	b. Increased diversions would increase salinity downstream.
Aquatic Resources	1. Construction would remove 1 acre of aquatic habitat in the South Platte River, or 192 lb. of trout.	1. Increased flows in North Fork of South Platte River would eliminate pools holding fish and reduce organisms requiring less velocity. Ecosystem below South Platte would change unquantifiably.
	2. Siltation would reduce bottom fauna and suffocate fish to reduce productivity an average 15% annually during 3 years of construction, a total of 1,224 lbs. of fish.	2.
	3. An increase from shoreline configuration to reservoir would increase total fish biomass 230%, but mainly non-game fish.	3.
	4. Inundation of spawning areas in 1.7 miles of stream would increase fishing upstream in fall.	4.
	5. One amphibian pond destroyed.	5.
	6. 44 feet drawdown of Dillon would concentrate fish and larger fish would survive. Exposing of mud flats would kill hibernating invertebrates or reptiles. Vegetation would freeze and recreation benefit.	6.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Geology, Minerals and Topography	1. Geology, mineral and topographic features would change, but not significantly.	1.
	2. Mining would be lost on the 95 acres to be occupied by dam and reservoir, but it is unlikely a minable ore deposit exists.	2.
	3. Seismic activity might increase by the impoundment of the water, unquantifiably.	3.
	4. 78% of 70,000 tons of sediment - 54,400 tons (21 ac-ft) - would probably be deposited in the reservoir annually.	4.
	5. 300,000 tons of aggregate would be excavated to construct the dam; no estimate of possible reserves has been made.	5.
	6. Access road cuts would be minor except from survey stations 340 + 50 and 354 + 50, where the old railroad bed would be eliminated.	6.
	7. At treatment plant, 4,490 lb. (3 cu. yds.) of sludge would be produced daily.	7. 28,500 lbs. of sludge would be produced daily.
Soils	1. Sedimentation: 28 acres would be disturbed in canyon from road constructions, to add 385 tons (0.3 ac-ft) of sediment to river in 10 years.	1.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Soils (cont.)	2. Power and Telephone Lines: 5 acres disturbed; 68.8 tons (1.036 ac-ft) of sediment added in 10 years.	2.
	3. Vegetation: clearing above high water line would disturb 30 timbered acres; 88% of sediments (60.5 tons) would deposit in South Platte initially; an additional 75 tons/yr. would be deposited over the 3-year construction period (225 tons total).	3.
	4. East portal area: 30 acres of disturbance.	4.
	5. Construction of Access Road: 11 acres disturbed; 22.5 tons (0.012 ac-ft) of sediment yielded.	5.
	6. Portal access, staging area, pond area: yield 100 tons (0.052 ac-ft) of sediment over 7 years.	6.
	7. Treatment plant complex: 145 acres disturbed, yield 167.5 tons annually of sediment with 335 tons (0.173 ac-ft) over 3 years. Also disturbed area would produce 935 tons (0.483 ac-ft) of sediment.	7. Treatment plant complex: additional 90 acres disturbed, producing 70 tons of sediment annually, 140 tons (0.07 ac-ft) over 2 years. Also, disturbed area would produce 1,445 tons of sediment: 95 acres would be disturbed between years 1983-2001, yielding 575 tons of sediment; 204 acres of vegetation would be disturbed; 114 acres permanently disturbed by structure.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Soils (cont.)	8. Conduit No. 27 would disturb 105 acres; 787.5 tons of sediment would be yielded over 5 years. The second parallel conduit would disturb 105 acres, yielding 787.5 tons of sediment between 1983-2001. These conduits would disturb a total of 210 acres of vegetation, none permanently.	8.
Terrestrial Resources	1. Vegetation: 136 acres disturbed, 128 permanently lost with 100 large trees; 582 acres temporarily disturbed, with 5 years required to return near-full production in grassland zones and 10 years in montane and riparian zones. Permanent loss of 27 acres of riparian habitat affected by 15 acre gain, a net loss of 12 acres, plus 10 years loss of habitat.	1.
	2. Wildlife disturbance would be general and adverse in canyon during construction.	2.
	a. Bighorn sheep: 3-year construction period would result in as much as 50% loss of herd.	a.
	b. Endangered Species: Peregrine falcon. Loss of riparian habitat and human harrassment could cause abandonment of nesting site.	b.
	c. Other animal species: one golden eagle eyrie would be deserted until after construction. Deer, mountain lion, and bear would be disturbed and driven out by construction. Raptors and other herds could be killed by flying into the power lines.	c.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Climate and Air Quality	1. Air pollution: fugitive dust and emissions for 30 months construction.	1.
	2. Accidental spillages could occur, but are unquantifiable.	2.
Noise	1. Construction could raise noise to 80-90 dBA 50 feet from the equipment; canyon and foothills now have 32-60 dBA. Blasting would also disturb the wildlife and people living nearby.	1.
	2. After construction ambient sound level would be reduced from 60 to 50 dBA.	2.
Visual Resources	1. Inundation and Increased Streamflows: radical but not unpleasant change at reservoir; sustained flow at river would reduce visual variety.	1. See Table 3-14 for summary of visual impacts at year 2001.
	2. Strontia Springs Dam: radical change to man-made feature from relatively disturbed landscape would produce high contract.	2.
	3. Dam Crest Road: linear scar would be produced.	3.
	4. Road Widening: high impacts in cut and line.	4.
	5. Staging Area: similar to dam.	5.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Visual Resources (cont.)	6. Power and Telephone lines: very prominent linear impacts.	6.
	7. Foothills Treatment Plant: radical change from structural, but not from landform or vegetative standpoint.	7.
	8. Conduit No. 27 and second parallel conduit not excessively high visual impacts.	8.
Cultural Resources		
Archaeological Resources	Impact significant because the plains area has potential site density, because archaeological sites are dwindling, and because there is evidence of Paleo-Indian sites, rarest in American archaeology. Damaged or destroyed or as yet undiscovered sites are of high impact.	
Historical Resources	1. Total loss of sites through the project are tabularized by impact.	1.
	2. Minor secondary impacts are also tabularized by impact.	2.
Paleontological Resources	204 acres at plant site and conduit excavations could encounter paleontological resources.	

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mdg 1/
Recreation	1. Vegetation removal would affect wildlife, especially Bighorn sheep.	1.
	2. Construction (3 years) would lose 30,000 visits.	2.
	3. Construction noise and activity would drive animals away, especially 50% of the Bighorn sheep herd.	3.
	4. Construction would cause loss of historical recreational viewing.	4.
	5. Dam would impose traffic barrier; through bicycle traffic would be eliminated.	5.
	6. Filling the reservoir would cut down fishing.	6.
	7. Recreation would change from rushing streams to placid reservoirs with attendant littering.	7.
	8. Access road would decrease wildlife habitat and aesthetic appearance. Power lines would also detract visually.	8.
	9. Upstream impacts would concentrate in the North Fork assuming flow schedules in upper South Platte would remain same.	9. On the North Fork, increased flows would reduce recreation; the amount is unquantifiable.

1/ Where blank spaces occur, no impact could be assessed.

TABLE 3-16 (cont.)

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE PROPOSAL

Environmental Element	Impact of 125 mgd	Impact of 500 mgd 1/
Land Use	1. 117 acres diverted by dam and reservoir to water diversion.	1.
	2. 9 acres of road; 8 more acres disturbed for 10 years.	2.
	3. 5 acres disturbed by power lines.	3.
	4. 30 acres of grazing land used for construction for 3 years.	4.
	5. Treatment plant construction disturb 135 acres for 3 years; 255 acres would be enclosed by security fencing.	5. Between 1983-2001, an additional 49 acres would be permanently and 90 acres temporarily disturbed.
	6. 65 acres would be open space; 320 acres would support 10 cows annually.	6.
	7. Conduit No. 27 and the second parallel conduit would disturb 105 acres of grazing land 5 years and 20 acres of cropland 1 year.	7. One additional large conduit would create same disturbance as Conduit No. 27.
	8. Density in residential use 0.1 mi/yr linear rate.	8. Present grazing land would probably become agricultural subdivisions.
	9. Rerouting of traffic would cause unquantifiable inconvenience. Traffic of 400 workers/day for 3 years. ADT volume from 7,900 to 8,300 vehicles per day.	9. 70 more vehicles per day and 2-8 trucks would be added.
	10. Overland flows might occur.	10. Overland flows might occur.

1/ Where blank spaces occur, no impact could be assessed.

CHAPTER 4

MITIGATING MEASURES

INTRODUCTION

The mitigating measures analyzed in this chapter are actions which will in some way reduce or eliminate impacts identified in Chapter 3. Each measure is analyzed in relation to a specific component of the proposed action, and the nature and degree of its effect is described. The mitigating measures will be required when and if the proposed project is approved.

Mitigating measures are required by governmental agencies with legal jurisdiction and will be monitored and enforced. Mitigating measures also include measures which the applicant, the Denver Water Board (DWB), has included as non-structural commitments, called Applicant Committed Measures. These will not be enforced; the DWB has committed themselves publicly to them.

Mitigating measures cover the east portal and staging area, the treatment plant complex, Conduit No. 27, and the second conduit parallel to it. In Waterton Canyon all mitigating measures including those proposed by the applicant concerning the U.S. Forest Service, BLM, and other public lands will be included in the right-of-way permits should they be issued. The project components in the canyon include access roads, the Stevens Gulch staging and portal area, the Strontia Springs Dam and Reservoir, and the power and telephone lines. Measures identified relative to these project components will be made conditions of stipulations of the permits and will be enforced jointly by BLM and USFS personnel.

MEASURES

Right-of-way: Dam, Reservoir, and Tunnel

Bureau of Land Management

1. BLM is limiting the clearing of vegetation to the area within the reservoir, which is below 6,010 feet of altitude, in order to decrease erosion associated with the project. This will also reduce turbidity in the South Platte River, benefiting aquatic life to an unquantifiable degree. The DWB will chip most of the vegetative material generated by clearing the reservoir area up to 6,010 feet of elevation and will dispose

CHAPTER 5

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

INTRODUCTION

This chapter presents a discussion of unavoidable adverse impacts which would be caused by construction and operation of the proposed Foothills Project. These include the residual impacts after application of the mitigating measures discussed in the preceding chapter.

SOCIO-ECONOMIC IMPACTS

During the three years of construction of the first increment of the proposed project (125 million gallons per day) there would be an estimated 43 accidents related to general construction, underground mining, and motorized transport. During construction of the second, third, and fourth increments (125 mgd each), there would be an additional 35 general construction accidents and 53 motorized transport accidents. During the life of the project, about twenty accidents would occur that would involve motor vehicle transports. Chlorine accidents would be expected to occur at a rate of once every eleven years; ammonia accidents would be expected once every 22 years. Although spills of these toxic chemicals are improbable, they would involve possible injuries and adverse temporary impacts on air quality.

An unavoidable adverse socio-economic impact of the project would result from the lay-off of 460 construction workers hired during the three-year construction period of the first increment. Assuming that the contract construction unemployed labor force of 3,753 in the Denver - Boulder LMA for March 1977 remains constant (Table 2-1), the impact on this unemployment rate would be to increase it by 12.3 percent. Though the work forces for the second, third, and fourth increments would not be as large as that for the first increment, an average of 27 per construction year or a total of 81, there would be unavoidable social and economic impacts to the construction workers and their families from lay-offs following completion of each increment. The total effect on the contract construction employment rate would be to increase it by 2.3 percent.

TABLE 5-6

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Socio-Economic	1. Accidents: 43 during 3 years of construction.	1. Accidents: 35 general construction accidents and 53 motorized transport accidents during construction of additional increments; 20 motor vehicle accidents during life of project; chlorine accidents 1 each 11 years; ammonia accidents 1 each 22 years.
	2. Employment and Manpower: layoff of 460 construction workers after 3 years.	2. Employment and Manpower: layoff of undetermined number of construction workers after each completed increment.
Water Resources	1. Surface Water	1. Surface Water
	a. 83,300 acre-feet per year would be diverted from Blue River watershed through Roberts Tunnel in 1990.	a.
	b. Strontia Springs Dam would create a new 95-acre reservoir in place of 1.7 miles of river.	b.
	c. Strontia Springs Diversion Dam would divert up to 193 cfs. Flows would average 60,500 ac-ft per year less than 1964-73 annual average of 298,000 ac-ft.	c.
	2. Water Quality	2.
	a. Additional Dillon diversions would deplete flow of Colorado River.	a.
	b. Salinity would increase: Cameo, Colorado now 440 mg/l would increase by 11 mg/l; Imperial Dam, Arizona now 861 mg/l, would increase by 7 mg/l.	b.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6 (cont.)

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Water Resources (cont.)	c. 447 tons (0.23 ac/ft) of sedimentation would be added to South Platte River during 3 construction years.	c.
Aquatic Resources	1. 1.7 miles of South Platte River would be converted into 1.7 miles of reservoir, suitable spawning areas will be lost, plus 1 amphibian pond.	1. Increased flows would cause unquantifiable bank erosion, and destroy 20 miles of riparian vegetation, which would destroy unquantifiable aquatic and terrestrial habitat and reduce fish crop.
	2. 10% reduction in surface area in 2.6 miles between Strontia Springs Dam and South Platte Intake; however, aquatic productivity would increase with adequate flows.	2.
Soils	1. Soil erosion and sediment yields would increase in 3 years construction and 7 years of operation; 397.5 tons (0.205 ac-ft) of sediment into Platte River, and 1.355 tons (0.700 ac-ft) from disturbed areas eastward.	1. Soil erosion and sediment yields would increase between 1983-2001 approximately 2,735.7 tons (1.4 ac-ft) and would not noticeably reduce productivity long-term on 509 acres impacted.
	2. 314 acres of soil (1,743 tons) would not reduce long-term productivity; 95 acres inundated and 76 acres covered by construction would lose productivity.	2.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED (cont.)

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd [1]
Geology, Minerals, and Topography	1. Concrete dam and excavation would change topography.	1.
	2. Reservoir would inundate upstream and below the 6,000-foot spillway.	2.
	3. Speculative prospecting on 95 acres of the reservoir would be lost.	3.
	4. Sand and clay deposits would be lost.	4.
	5. 74% (52,000 tons) of sediment from the river would be deposited in the reservoir; waters leaving would only carry away 26% of that amount.	5.
	6. 300,000 tons of aggregate would be excavated for construction.	6.
	7. 4 acres would be leveled for Stevens Gulch staging area.	7.
Terrestrial Resources	1. Vegetation: 108 of 124 disturbed acres would be lost by construction. 14 acres of riparian vegetation would be lost, but probably return to productivity in 5-10 years.	1.
	2. Wildlife: harassment, illegal killing, noise would all disturb wildlife and some would be lost (unquantifiable); some would return after construction is complete.	2.

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[1] Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED (cont.)

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Terrestrial Resources (cont.)	a. Bighorn sheep: probably 50% reduction from construction to 30-35 head, affecting 5,000-6,000 recreation visitors to the canyon. b. Disturbance of riparian habitat by higher flows could cause abandonment of Peregrine falcon nest. c. Deer, mountain lions, and bear would be driven out, but they are few.	
	3. Conduit construction would disturb 85 acres of grassland vegetation, 20 acres of cropland, bisect 2 prairie dog colonies and dislodge antelope temporarily from 8% of their 3,000 acre range for 10 months. These impacts are not significant.	3.
Climate and Air Quality	1. Dust and vehicle emissions resulting from Foothills would be highest during construction, but are unquantifiable after mitigation of watering. 2. Ammonia or chlorine spills are unlikely, but would degrade air quality if they occurred.	1. Dust and vehicle emissions resulting from Foothills would be highest during construction, but are unquantifiable after mitigation of watering. 2. Ammonia or chlorine spills are unlikely, but would degrade air quality if they occurred.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6 (cont.)

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Noise	Construction would raise noise from 32-60 dBA and adversely affect wildlife and people. After construction the sound level would be reduced from 60 to 50 dBA. Construction equipment can range from 85-95 dBA at 50 feet away; however, sound level would lower after construction.	Construction would raise noise from 32-60 dBA and adversely affect wildlife and people. After construction the sound level would be reduced from 60 to 50 dBA. Construction equipment can range from 85-95 dBA at 50 feet away; however, sound level would lower after construction.
Visual Resources	1. Inundation would change the Waterton Canyon from a canyon to a placid lake; however, then radical change would not be displeasing.	1. Those visual elements which were part of the original 125 mgd construction would remain the same contrast, lessened only by their relative absorption into existing surroundings. For new visual elements resulting from construction for the additional increments, the classification would be greater in impact. Since those impacts have already been generated, the anticipated impacts of both conduits are relatively small.
	2. According to BLM's Visual Management Classification, construction elements would present the greatest contrast to the existing environment (Tables 5-4 and 5-5).	2.
	3. Strontia Springs Dam would impose a man-made feature on a relatively undisturbed landform, not necessarily an adverse impact.	3.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6 (cont.)

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Visual Resources (cont.)	4. The color, flow and character of the river would change.	4.
	5. The Dam Crest Road would be a visible linear scar.	5.
	6. Road widening would result in high impact in form and color.	6.
	7. The staging area would result in high impact from a color standpoint.	7.
	8. Power and telephone lines would result in high structural impact.	8.
	9. The Foothills Treatment Plant would highly impact the landscape in excess of visual management contrast limits from a structural as well as vegetative standpoint.	9.
Cultural Resources Archaeological Resources	Construction would bury, destroy, or remove archaeological resources both known and unknown.	Construction would bury, destroy, or remove archaeological resources both known and unknown.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6 (cont.)

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Historical Resources	The following sites would be lost: Keystone Bridge, 2.6 miles of DSP&PRR roadbed, 1.7 miles of D&RGRR rockwork, Deansbury Station and Strontia Springs site, telegraph poles in the floodpool, and the modern railroad bridge. Any opportunity for future study would be lost.	The following sites would be lost: Keystone Bridge, 2.6 miles of DSP&PRR roadbed, 1.7 miles of D&RGRR rockwork, Deansbury Station and Strontia Springs site, telegraph poles in the floodpool, and the modern railroad bridge. Any opportunity for future study would be lost.
Paleontalogical Resources	Excavations would encounter and disturb paleontalogical resources.	Excavations would encounter and disturb paleontalogical resources.
Recreation	1. Habitat for wildlife and numbers of wildlife would decrease.	1.
	2. 18,000 recreational visits would be lost during construction.	2.
	3. The narrow gage railroad would be lost.	3.
	4. 1.7 miles of stream trout fishing would be replaced by bank fishing.	4.
	5. The dam would attract visitors (and increase litter).	5.
	6. Higher flows would decrease safety for recreationists.	6.
	7. People, traffic, and noise would reduce recreation quality.	7.
	8. Mudflats would increase from drawdown in Dillon Reservoir.	8.

1/ Where blank spaces occur, no impact could presently be assessed.

TABLE 5-6

SUMMARY TABLE OF ADVERSE IMPACTS WHICH CANNOT BE AVOIDED (cont.)

Environmental Element	Impacts at 125 mgd	Impacts at 500 mgd 1/
Land Use	1. 117 acres would convert from forest to water diversion use.	1. Addition of incremental plant units would occupy an additional 49 acres, with 90 acres temporarily disturbed; 65 acres would remain as open space; 320 acres would be lost to grazing.
	2. Roads would occupy 17 acres.	2. Construction of Conduit No. 27 would disturb 105 acres of grazing land for 3 years. The same acres would be disturbed when the additional parallel conduit is built.
	3. 4 acres in Stevens Gulch would be disturbed for 3 years and would take 5 years to recover.	3.
	4. 30 acres of grazing land would be used for construction.	4.
	5. 135 acres would be disturbed for 3 years of construction, and 65 acres would be lost to structures.	5.
	6. Security fencing would enclose 255 acres.	6.
	7. Vehicle traffic would be restricted in construction area. Volume of traffic would increase from 7,900 to 8,300 vehicles per day on Highway 75.	7. 15 cars would be added per day between 1983 and 2001.

1/ Where blank spaces occur, no impact could presently be a

CHAPTER 6

THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

This chapter discusses productivity of the environment which would be affected by the construction and operation of the proposed Foothills Project. In this context, "short-term" refers to the three years required to construct the components of the Foothills Project at 125 mgd, and the three additional two-year construction periods necessary to bring the treatment plant to 500 mgd. "Long-term" refers to the estimated 75-year project life. Beyond 75 years, the dam and reservoir would probably continue to affect productivity, since the removal of this structure would not be practical. It is assumed that other aboveground, permanent facilities would be removed and partially salvaged and the affected areas reclaimed.

In total, about 580 acres of land in a naturally productive state would be disturbed during construction of the 125 mgd plant, of which 76 acres would be occupied by man-made buildings, roads, trails, and structures, and 95 acres of aquatic and terrestrial habitat would be transformed from stream to reservoir habitat. Uses on the remaining 409 acres would be modified temporarily or disturbed by short-term construction-related activities. An additional 309 acres would be disturbed during expansion to 500 mgd capacity.

The short-term uses on the 383 acres would reduce natural productivity during construction and a three- to five-year restoration period. During this time about 447 tons of vegetation would be lost. Long-term annual production thereafter would be unaffected. The occupation of 76 acres by structures would eliminate natural productivity; a long-term net loss of biomass during the 125 mgd construction phase and in the 500 mgd construction phase is not quantifiable.

Filling of the proposed reservoir would inundate 95 acres of terrestrial habitat and replace it with a relatively sterile aquatic habitat. Terrestrial biomass estimated at 4,000 tons would be lost during the 75-year project life, and since it would remain afterwards, the dam would continue to reduce biotic production about 42 tons annually thereafter. The short-term construction uses in Waterton Canyon would affect long-term land uses on 117 acres (to high-water line), by eliminating most land use options in the future. However, casual land uses such as recreational and wildlife use would continue. Of the 117 acres, 38 acres would be federally managed, and multiple uses would be restricted to uses associated or compatible with the primary purpose of water diversion.

The removal of vegetation and associated soil disturbances would increase sediment yield by 1,752.6 tons in the short-term construction and restoration period. As vegetation became reestablished, sediment production would stabilize at a near natural level. During the construction and restoration period, 397.5 tons of the additional sediments would be added to a 2.6-mile stretch of the South Platte River. The loss of about 35 head of Bighorn sheep would be associated with construction in Waterton Canyon. In the long-term, the herd would regain its present level of 60-65 head, and production would return to present levels.

Human interest values would be significantly impacted in both the short- and long-term. Closure of Waterton Canyon to public use during the three years of construction would eliminate 18,000 visits for recreation use and aesthetic enjoyment. Over the long-term and beyond, although the canyon would be re-opened to public use, the use would be changed from those opportunities associated with a free-flowing stream in a rugged, relatively untouched setting, to those associated with a setting dominated by the dam, reservoir, and other man-made facilities.

The local short-term use of the project area would entail disturbance within the area of the old DSP&P right-of-way and the old Denver and Rio Grande rockwork roadbed below the damsite.

Upstream short-term and long-term uses would be about the same. With increased flows, there would be short-term damage to certain historical sites within the North Fork Historic District. However, over the long-term, these impacts would be secondary in nature and would be relatively minor.

East of the Foothills Project site there would be a loss of opportunities to study undiscovered archaeological sites and paleontological resources. Although these cultural resources would be identified and recorded during construction, the options for future interpretation and study would be lost.

The landscape resulting from the proposal would be permanently altered. It would display more intrusions than at present, and would thus affect those who view it. The degree of scenic degradation would vary with the location of the viewer and would be directly related to the unavoidable impacts indicated on Table 5-4.

Although silt would be added during the short-term construction period, the proposed dam would trap 2,110 acre-feet of silt annually over the 75-year project life and reduce turbidity in 2.6 miles of the South Platte River below that point. This probable improvement in aquatic habitat would be more than offset by the reduction in flows in that area. Trout production would be reduced by 10 percent, or 95 pounds annually, for a total loss of 7,125 pounds of trout during the long-term (75-year) life of the project.

In the short-term, grazing use would be affected by construction on 350 acres and dry farm production would be affected on 20 acres. In the long-term, future land use on 610 acres would be affected. Of the 610 acres, 485 acres at the proposed treatment plant complex are presently grazing lands. At 125 mgd capacity, 65 acres would be occupied by structures. Security fencing around the facilities would enclose about 255 acres. Incremental addition of plant units to attain 500 mgd treatment capacity would eventually occupy an additional 50 acres. About 65 acres outside the security fence on the west side of the plant would be impractical to use for grazing, and would be open space.

The Denver Water Board (DWB) would expect to continue to lease their lands for livestock grazing, about 165 acres north of and outside the security fence. In the long-term, 105 acres of land within the DWB's existing right-of-way for proposed Conduit No. 27 and the second conduit parallel to it would be lost from possible development for residential use.

During the short-term construction period, the Foothills Project would use about 28.9 million kilowatt hours of electrical energy. In the long-term, however, the hydrogenerator would produce 11 million kilowatt hours annually at 125 mgd, and 78 million kilowatt hours at 500 mgd. The plant and dam operation would use 8 million kilowatt hours annually at 125 mgd, and 13 million kilowatt hours at 500 mgd. Over the life of the project, therefore, there would be a net gain of over 128.6 million kilowatt hours of electrical energy for sale and ultimate consumption with the plant operating at 125 mgd.

Assuming that the unemployment level among transportation and public utilities workers remains stable, the permanent work force needed to maintain the entire proposed project would reduce the unemployed transportation and public utilities labor force of 649 (Table 2-5) in the DBLMA by 5.4 percent, thus maintaining and enhancing the long-term productivity of 35 families.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

This chapter identifies the extent to which the proposed action would irreversibly diminish the range of potential uses of the land and its resources. In this context the term irreversible is defined as use that is incapable of being reversed; once initiated, it would continue. The term irretrievable means irrecoverable; once used, it is not replaceable.

Although the natural productive capacity of impacted land and water resources would be regained in the short-term or long-term, or after the 75-year project life, interim production would be lost. Those production losses, cited in Chapter 6, would be irretrievable.

The Denver Water Board (DWB) has constructed and is operating facilities which can provide a reliable raw water supply to Waterton Canyon of 206,000 acre-feet per year after losses. The commitment to use this water has been made, and construction of the Foothills Project at 125 mgd does nothing to modify that commitment. The expansion of the proposed Foothills Treatment Plant from 125 mgd to a capacity of 500 mgd to meet the max-day demands of the projected population will be concurrent with the development of additional sources of raw water to satisfy the annual demand of that population.

When and if such expansion occurs, additional water resources whether they originate in the Colorado River Basin or the South Platte River Basin, will be committed to use by users within the DWB service area.

Construction of the Foothills Project would require 450,000 tons of aggregate, 73,000 tons of cement, and 19,000 tons of steel. Except for possibly 5,000 tons of steel which could be practically salvaged, these resources would not be recovered and would be considered irretrievable.

The visual impacts identified as unavoidable in Chapter 5 constitute irreversible and irretrievable commitments of resources. From the practical standpoint, even if the entire project were abandoned sometime after construction, it would be nearly impossible to return the dam and reservoir area, all constructed roads, the staging area, Conduit No. 27, and the second parallel conduit, to a natural or quasi-natural state.

The dam and reservoir in Waterton Canyon would irreversibly change the 95 acres of aquatic and terrestrial habitat into reservoir habitat. Associated with the construction of the facilities will be the loss of 35 Bighorn sheep. Higher flows could reduce the falcons' feeding area enough to cause abandonment of the nesting site. The 18,000 recreation visits to the canyon would be irretrievably lost during construction.

Recreational use patterns and trends would be altered, and land use options not compatible with the dam's presence would be eliminated. Considering present technology this structure could not be practically removed; these effects, therefore, could not be reversed at any time in the foreseeable future.

The construction of the proposed project would cause all known or unknown archaeological, historical, and paleontological resources to be preserved only as data, destroyed, or removed from context. Although there may be other similar cultural sites and values at other locations, the loss of these particular resources would be considered an irretrievable commitment.

Those sites within Waterton Canyon above the damsite will continue to be irreversibly and irretrievably committed as total losses. These sites include the DSP&P railbed, the Deansbury Station site, the Deansbury Bridge, and the D&RG railbed above the damsite. Below the dam, the Keystone Bridge would be totally lost, through the radical change of the canyon environment and massive modifications in the area.

Those sites along the North Fork of the South Platte River in the North Fork Historic District will not be irreversibly committed since they will not be lost.

There would be a good chance that buried archaeological and/or paleontological resources would be destroyed and lost at the treatment plant complex, and along Conduit No. 27 and the second parallel conduit; this commitment would be irretrievable.

The 65 acres which would be occupied by permanent structures at the treatment plant would lose their natural productivity for the life of the project, as would an additional 50 acres that would eventually be occupied by increments to attain the 500 mgd plant capacity. The right-of-way for Conduit No. 27 and the second parallel conduit, along with Aurora's adjoining right-of-way, would control future land uses. During the 75-year project life, the rights-of-way would result in residential or similar layout and design development in adjoining areas, to accommodate the restrictions against permanent structures within the right-of-way.

These developments would remain long after the life of the project, as would their layout and design features. It would be possible for adjoining uses to extend onto the right-of-way after 75 years; however, the adjoining developments would still control layout and design over the conduits. The developmental layouts and design would be irreversible.

A commitment of electrical energy would be associated with the construction and operation of the proposal. Construction would require about 28.9 million kilowatt hours; 8 million kilowatt hours annually, or a total of 667.5 million kilowatt hours, would be used over the 75-year project life. This represents a total commitment of 696.4 million kilowatt hours of electrical energy. However, since those 8.9 million kilowatt hours would not be produced without the project, only the 28.9 million kilowatt hours lost to construction would be irretrievable. In summary, there would be a commitment of $133,539,000 in goods, services, and manpower over a three-year period for construction of the first increment of the proposed project. To complete the second, third, and fourth increments would require commitment of an additional $131,084,000 in physical and human resources by the 2001.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

Two categories of alternatives were considered: (1) major alternatives, which include options for no action and changes in structure and location, and (2) minor alternatives, which pertain to options regarding a single component of the project.

The alternatives are described and analyzed under the assumption that appropriate mitigating measures proposed in Chapter 4 would be applied to each alternative. Mitigated impacts of each alternative are described to the extent that the option differs from the proposed action. Table 8-1 compares impacts of the proposed action and the major alternatives.

Besides the alternatives analyzed, numerous other alternatives were considered but were rejected because they were not technically feasible or they would result in unacceptable environmental impacts.

In addition, an analysis is presented on alternatives for potential raw water sources. Although these are not a part of the proposed Foothills project and are not discussed elsewhere in the statement, they are appropriate to be included, because existing reliable water sources will be fully utilized during the life of the project.

MAJOR ALTERNATIVES

No Action

Description

Under the no action alternative, the Bureau of Land Management (BLM) would deny the right-of-way application for construction of the Strontia Springs diversion dam and reservoir, tunnel, and access road improvements.

Analysis

A rejection of the Denver Water Board's (DWB's) right-of-way applications would restrict expansions of its raw water diversion facilities in Waterton Canyon. As a result, it is assumed that the proposed Foothills treatment facilities and treated water conduit, as described in Chapter I of this statement, Proposed Action, would not be constructed.

TABLE 8-1

COMPARISON OF IMPACTS OF THE PROPOSAL AND MAJOR ALTERNATIVE

Area of Impact	Proposed Action	No Action	Upstream Alternative	Chatfield Alternative
SOCIO-ECONOMIC				
No. of jobs for 3 years	400 jobs	0	300 jobs	250 jobs
Water shortage days in 1990	0	40 days	0	0
2000	0	63 days	0	0
Date raw water becomes limiting factor	1988	1990	1988	1988
Electric energy (per year)				
At 125 mgd:	Produce: 11,000,000 kwh	0		0
	Use: 8,000,000 kwh	0	8,000,000 kwh	58,773,000 kwh 1/
	Surplus: 3,000,000 kwh	0		0
At 500 mgd:	Produce: 78,000,000 kwh	0		0
	Use: 13,000,000 kwh	0	13,000,000 kwh	216,066,000 kwh 1/
	Surplus: 64,000,000 kwh	0		0
WATER				
1988 average annual flow in the South Platte above the Platte Canyon intake	328 cfs	521 cfs	328 cfs	521 cfs
AQUATIC RESOURCES				
Miles of stream lost	1.7 miles	None	0.5 miles	None
Replaced by acres of reservoir	95 acres	NA	8 acres	NA
Geology, topography, and minerals	Speculating prospecting for iron, copper, or uranium would be impossible for at least 75 years.	None	None	None

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1/ This does not include carbon regeneration.

TABLE 8-1 (cont.)

COMPARISON OF IMPACTS OF THE PROPOSAL AND MAJOR ALTERNATIVE

Area of Impact		Proposed Action	No Action	Upstream Alternative	Chatfield Alternative
SOILS					
Sediment yield (additional above present) for project life	125 mgd	1,752.6 tons	None	1,793 tons	1,175 tons
	500 mgd	3,886.3 tons	None	3,926.7 tons	1/
TERRESTRIAL RESOURCES					
Vegetation permanently lost	125 mgd	193 acres	None	75 acres	65 acres
	500 mgd	307 acres	None	189 acres	1/
Vegetation temporarily lost (3-5 years)	125 mgd	387 acres 1/	None	389 acres 2/	313 acres 2/
	500 mgd	582 acres 2/	None	584 acres 2/	1/ 2/
Type of Bighorn habitat limited during construction		Summer range Winter range Lambing grounds Breeding areas	None	Summer range	None
Reduction on Bighorn population		From 60-65 to 30 head	None	From 60-65 to 45 head	None
Golden eagle eyries disturbed		One eyrie	None	Two eyries	None
Loss of habitat for other species in miles of canyon bottom		4 miles	None	8 miles	None

---

1/ Data not available for 500 mgd. for Chatfield.

2/ The second parallel conduit would redisturb a portion of these habitat acres; it is not quantifiable.

TABLE 8-1 (cont.)

COMPARISON OF IMPACTS OF THE PROPOSAL AND MAJOR ALTERNATIVE

Area of Impact	Proposed Action	No Action	Upstream Alternative	Chatfield Alternative
CLIMATE AND AIR QUALITY	Air quality in the construction area will be degraded by dust and vehicle emissions in amounts too small to measure	None	Same as proposed action	Same as proposed action
NOISE				
Intermittent noise levels in construction area	90 dBA	None	90 dBA	90 dBA
VISUAL RESOURCES				
Inundation and increased stream flows 125 mgd	Low	Low	Low	Low
500 mgd	Moderate	Moderate	Moderate	Moderate
Dam	High 1/	None	High 1/	None
Access roads	High	None	High	Low 2/
Staging area	High	None	None	None
Power and telephone lines	High	None	High 2/	Low 2/
Water treatment facility 125 mgd	High 1/	None	High 1/	High 1/ 2/
500 mgd	Low	None	Low	Low 2/
Conduit No. 27 2nd Parallel Conduit	Low	None	Low	Low 2/
Tunnel muck disposal	Low	None	High 1/	None

1/ Indicates a contrast in excess of BLM standards for the area and visual management class involved.

2/ Alternate location.

TABLE 8-1 (cont.)

COMPARISON OF IMPACTS OF THE PROPOSAL AND MAJOR ALTERNATIVE

Area of Impact	Proposed Action	No Action	Upstream Alternative	Chatfield Alternative
CULTURAL VALUES				
Archaeological features lost	Undiscovered features lost; cannot be quantified	None	Undiscovered features lost; cannot be quantified	None
Historical features lost	1.7 miles narrow gage railroad grade (DWP&P; D&RG, Deansbury Sta., Strontia Springs site, Keystone bridge)	None None	1/2 mile narrow gage railroad grade (DSP&P, D&RG)	None
Paleontological features lost	Undiscovered features lost; cannot be quantified	None	Undiscovered features lost; cannot be quantified	None
RECREATION				
Visitor days lost during construction	18,000 (3-year construction period)	None	40,000 (4-year construction period)	1.4 million (1-year construction period)
LAND USE				
Land use options lost	727 acres	None	588 acres	312 acres

Cultural Resources

This alternative would prevent the loss of the Keystone Bridge, 2.6 miles of DSP&P modified rail road bed, 1.7 miles of Denver and Rio Grande rockwork, the Strontia Springs site and the Deansbury Station site. In addition, the upper (Deansbury) bridge would not be damaged. There would be no increased water flows along the North Fork and the North Fork Historic District would not be impacted through increased flows.

Chatfield Alternative

Description

As an alternative to the proposed action, a treatment plant and pumping station could be constructed at Chatfield Reservoir, twelve miles downstream from the proposed Strontia Springs Dam. Raw water would be pumped from Chatfield Reservoir and piped about 7,000 feet to a treatment plant located between West Plum Creek and the South Platte River (Figure 1-3). A raw water conduit 108 inches in diameter would link the intake tower to the treatment plant. The intake tower and pump station would be located southeast of the existing Chatfield Dam intake tower (Figure 1-3). The tower would be 120 feet high (to ensure it being above the flood pool level) and would include trash racks. Pumps would be capable of lifting water from the 5,426-foot elevation at the intake to the 5,530-foot elevation at the treatment plant (470 feet). Chatfield Reservoir would have to be drained for about one year to allow for construction of the intake structure, pump station, and intake conduits.

The water treatment plant would be similar to the proposed Foothills plant; however, filtration capacity would have to be substantially greater because of lower water quality. About 200 acres of land would be required for the plant with no buffer. Access would be by existing roads. As opposed to the on-line or base nature of the proposed Foothills plant, the Chatfield facility would be employed as a peaking plant, operated as needed to ensure that demands for water do not exceed base-treatment capabilities at Moffat and Marston.

The Chatfield alternative would require large amounts of electrical energy to accomplish the required pumping. Annual energy consumption would range from about 59,442,000 kilowatt-hours initially at the 125 mgd level to about 217,730,000 kilowatt-hours at the 500 mgd level of plant capacity. These figures include both the pumping that the Foothills plant could eliminate from the existing system. To help put this in perspective, the DWB's total consumption during 1975 was about 48,000,000 kilowatt-hours.

Because congressional approval is needed to make a change in the utilization of Chatfield Reservoir, as well as new design and engineering requirements and environmental statement, the DWB estimates that a plant at the Chatfield site could not be operational until 1986.

Treated water would be pumped from the treatment plant to the Hillcrest Reservoir via an alternative Conduit No. 27 (Map 1-3) and the required portion of Conduit No. 27. The alternate 108-inch conduit would follow Roxborough Park Road south to Titan Road and then turn east to intercept the proposed alignment of Conduit No. 27. The total length of Conduit No. 27 would be about 15.5 miles (5,000 feet less than proposed). The design for an alternate Conduit No. 27 would be the same as for the proposal.

The Chatfield alternative would provide a minimum of 4,000 acre-feet of storage. As much as 24,000 acre-feet of storage capacity could conceivably be utilized without the approval of Congress, but 20,000 acre-feet of this capacity is allocated to 100 years of sedimentation and theoretically would not be available after that period. Use of more than 24,000 acre-feet would require congressional approval.

Analysis

Socio-Economic Conditions

Social and economic impacts would occur both during the three-year construction period and during the life of the project. There would be significant human and social impacts on about 250 families or individuals who would receive average gross incomes of not under $16,000 (Table 2-3). Present trends in water consumption could be continued until about 1988.

Water Resources, Aquatic Resources and Soils

Because the existing treatment plants would function as base plants, most of the raw water for treatment would be diverted at the existing Platte Canyon and Highline Canal intakes. Flows below these points would be increased only during periods of peak demand.

Flows through the Waterton Canyon and into Chatfield Reservoir would probably bring about increased bank erosion, channel scouring, and sedimentation rates, with the result that the 100-year projected life of the reservoir would be somewhat reduced. The full extent of this impact is contingent on the intensity of use of the treatment plant and the commitment requirement for raw water. Since flows of equal magnitude would occur in the canyon to the South Platte intake without the project, the impact there is only one of timing, i.e., impacts related to high flows would occur earlier than without the project. Below the South Platte intake higher flows would occur on the peak demand days, when, without the project, shortages would occur (Table 1-3).

site would be located on about 200 acres of land designated as open area and would abut lands designated for overnight use and natural or environmental study (Corps of Engineers 1974, plate 3).

Land Use

Table 8-1 summarizes the development of the Chatfield Dam Alternative. As with both the project proposal and the No Action alternative, major topographic, social and economic factors other than presence or absence of any part of the project would control general land use except for the areas actually occupied by project features.

About 252 acres of land presently being used for grazing and about 60 acres of land being dry farmed would be committed to a municipal water works. This would preclude using these lands for other purposes during the life of the project.

At 125 mgd, 75 acres would be used by installation of Conduit No. 27 and at 500 mgd, an additional 75 acres would be used for the additional conduit.

It is probable that urban growth would continue at its present rate, that is, areal urban development of 73 acres annually within one mile of Conduit No. 27 and the second parallel conduit, and a lineal growth rate of about 0.1 miles annually from north to south.

Upstream Dam Alternative

Description

Another alternative to the proposed action would involve construction of a lower dam farther upstream from the Strontia Springs site. A tunnel 8.5 feet in diameter would convey raw water to the proposed treatment plant site. The treatment plant would operate as a base plant and would have the same design as the proposed plant. The diversion dam, located about 10,500 feet upstream from Stevens Gulch and about 200 feet upstream from the City of Aurora's existing water intake for the Rampart Tunnel, would be a concrete gravity flow dam with the entire section acting as an uncontrolled overflow spillway. At an elevation of 6,030 feet, the dam crest would be 50 feet above the streambed with a crest length of approximately 200 feet.

The intake for the tunnel would be an integral part of the dam structure, located approximately at the 6,030-foot level. It would have a simple gated inlet equipped with a trash rack. Sluice gates would be installed in the center of the dam.

At the crest elevation of 6,030 feet, the reservoir would extend about 2,500 feet upstream from the dam, inundate approximately eight acres of land, and contain 97 acre-feet of water. The reservoir would have little sediment-settling capabilities as water turnover would be rapid. Accumulated sediments would have to be removed each year by dredging to maintain the diversion facility. The reservoir has a trap efficiency of ten percent; it would trap about 7,000 tons of sediment annually.

All vegetation below the 6,030-foot elevation would be chipped, removed, and scattered over disturbed areas above the high-water line of the reservoir. About eight acres of brush with a few scattered Douglas-fir trees would need to be cleared.

Construction of the dam would require about 15,000 cubic yards of concrete and 125 tons of steel. Concrete would probably be hauled in from a staging area at South Platte to a two-acre staging area that would be located in the canyon near the damsite.

The west portal of the tunnel would be located just upstream from the right abutment of the dam, while the east portal would remain in the same location as it is for the proposed project. No other portals would be necessary. Tunnel alignment would follow a nearly straight line between the two portals. Tunnel length would be approximately 26,500 feet. With a pay line of 10.5 feet in diameter to blasted rock and a finished inside diameter of 8.5 feet, the concrete-lined pressure tunnel would have a capacity of about 1,100 cubic feet per second (710 mgd). Construction of the tunnel would proceed simultaneously from both portals. Approximately 38,500 cubic yards of tunnel muck would be taken from each portal. Muck from the west portal, together with about 23,000 cubic yards of material excavated from the dam foundation, would be deposited on DWB property along a sand bar near the confluence of the South Platte and its North Fork. Approximately seven acres would be covered to a depth of about three feet. Site reclamation and runoff preventatives would include providing cutoff trenches to prevent drainage, replacing topsoil and revegetating. Muck removed from the east portal would be deposited at the site selected for the proposed project tunnel.

Operation of the treatment plant would produce about 16,100 pounds of sludge per average day at 125 mgd, 38,600 pounds at 500 mgd per average day. Sludge drying ponds would be cleaned three to four times annually. During the life of the project, about 15 acres in the disposal area would be filled and leveled at 125 mgd, 90 acres at the 500 mgd level.

Winter icing conditions would cause this diversion structure to be operative for only nine months of the year and necessarily change the Foothills Treatment Plant operation strategy.

Primary access to the damsite would be from Sedalia through Nighthawk, approaching the dam from the southwest. Although this route has a steep grade at Nighthawk, a historical site, it would be improved to accommodate construction traffic. About five miles would require substantial improvement and realignment and would affect about 30 acres. From the town of South Platte, which is within the North Fork Historic District, to the dam, the road would be improved to a width of 14 feet with turnouts.

A second access route would be from Kassler through Waterton Canyon. Although this route is shorter, the road would require some improvement in order to upgrade it to a 14-foot road with turnouts. Public access would not be permitted along this route until after the construction period.

A 13.2-kilovolt aerial powerline would be constructed from Platte Canyon intake to provide power required for construction of the dam and west tunnel portal. This permanent power line would provide power needed at the dam for operational purposes.

Construction time and manpower for the alternate tunnel would be about 60 percent greater than that required for the proposed project tunnel. Construction fo the dam would require about one year. The overall construction schedule for the project would not change. Overall this alternative would employ an average of 300 persons for about three years.

The operation of the upstream diversion system and treatment plant would require the use of about eight million kilowatts of electricity annually, which would be purchased from electric power companies in the area. This would represent a long range commitment of energy sources that are being depleted to generate electricity.

Analysis

Socio-Economic Conditions

Social and economic impacts similar to those described for the Chatfield alternative would occur if this alternative were pursued. There would be significant human and social impacts on about 300 families or individuals who would be employed and receive average annual incomes amounting to about $16,050. Trends in water consumption and water shortages would be the same for both alternatives as they both provide treatment capability approximately equal to the proposal.

Water Resources

By 1988 average annual flows in the South Platte River below the upstream dam would be 521 cubic feet per second (cfs) without the project. Below the point of diversion, flows would be reduced to 328 cfs, as 193 cfs (at 125 mgd) would be diverted to the treatment plant. Reduced flows would be

Analysis

Since the underground power lines would not be visible, the adverse impacts related to aesthetics and recreation on about 3.2 miles of aerial power lines would be eliminated. The potential for electrocution of raptors and inflight collisions with conductors would also be eliminated.

Parallel Bridge to the Keystone Bridge

Description

Instead of removing the historic Keystone Railroad Bridge and building a new vehicular bridge across the South Platte River in the Waterton Canyon as part of the access road construction, a parallel bridge could be built downstream. The Keystone Bridge would then be used for non-vehicular traffic (hikers, bikers, etc.) and as an historic interpretive site, with displays of the historic resources within the Waterton Canyon.

Analysis

The construction of the second bridge slightly downstream of the present railroad bridge would have certain environmental impacts. The second bridge would necessitate the construction of new abutments at the stream edge, and new center supports in the stream itself. These would impact aquatic resources, and yield sediment to an unquantifiable degree. A side hill cut, impacting visual resources to an unquantifiable degree, would be needed to achieve adequate right-of-way for the parallel bridge. This minor alternative would preserve the historic resource and setting to a much higher degree than removal of the bridge would provide.

ALTERNATE NEW SOURCES OF RAW WATER

Introduction

General

The Department of the Interior directed that this redraft of the Foothills Draft Environmental Statement include a discussion of new sources of raw water needed to meet the 500 mgd capacity of the Foothills Treatment Plant. A letter dated November 1, 1976, from Jack Horton, Assistant Secretary of the Department of the Interior, Land and Water Resources, stated:

> The subject document should also be expanded to identify and assess the environmental impacts associated with the various alternative sources of water supply, storage, and transmission, including transmountain diversion if necessary, that could reasonably be expected to meet the 500-mgd capacity of the Foothills treatment plant. The discussion of alternative sources of water supply and storage facilities should include:
>
> a) the Chatfield reservoir;
> b) enlargement of Gross reservoir;
> c) extension of the Williams Fork collection system;
> d) transfer of South Platte and Bear Creek ditch rights;
> e) exchange of transmountain effluent;
> f) the proposed Two Forks project.
>
> Because specific supply sources or systems have not been proposed at this time, these alternatives should be treated generally as to their adequacy in terms of single units, or in combination to supply the 500 mgd Foothills treatment operation. It should also be stated that a future site-specific environmental assessment will be required for any eventual decision and action that is related to the development of these alternative water supplies.

Based on this clear directive, a memorandum of understanding was written to Bureau of Land Management from Bureau of Reclamation stating:

> It is our intention to discuss those alternatives which can reasonably be expected to enable the Denver Water Board to have waters available for treatment at a Foothills plant with a capacity of 500 mgd. The facilities associated with such alternatives may include storage and collection systems on the West Slope, East slope storage necessary to regulate transmountain diversions and/or waters obtained through acquisition of agricultural water rights.
>
> There will be no attempt to show engineering feasibility or economic justification for any of the water supply alternatives. The discussion of water supply alternatives will be limited to a few (two or three) most reasonable methods of meeting the 500 mgd requirements for the Foothills plant. Reclamation will furnish complete writeups on each . . .

In addition, in the approved Environmental Statement Preparation Plan for the Foothills Project (February 8, 1977) a directive is provided for the method of inclusion of this material. It states:

> . . . the revised DES will identify and assess, in a special section of the Alternatives chapter, the general environmental impacts associated with developing alternative additional sources of raw water supply . . .

This section discusses alternative new sources of raw water supplies, and three possible concepts to provide raw water supplies to the Denver Water Board's (DWB) Denver metropolitan service for municipal and industrial use. In describing these concepts or scenarios, the detail is less than appraisal level, and the discussions on features, operations and corresponding environmental impacts of the three concepts are covered in a general manner.

Although there may be any number of other combinations of existing and potential features which could be utilized to develop the required raw water supplies, the three concepts presented here were determined to be representative of alternative new sources of raw water supplies for treatment by the potential Foothills Project.

These potential concepts and their individual features would require a complete and detailed environmental analysis under NEPA (1969), and the preparation of specific Environmental Statements.

Likewise, during the detailed investigation of potential features, historic and cultural resources would be inventoried by qualified personnel as required by Executive Order (E.O.) 11593. Determinations of eligibility for National Register of Historic Places would be made, and Advisory Council on Historic Preservation afforded an opportunity to review resources in accordance with Regulations of Advisory Council on Historic Preservation - Protection of Properties on the National Register; Procedures for Compliance. Other legislation requiring compliance include: the 1906 Antiquities Act, the 1935 Historic Sites, E.O. and the 1974 Historical and Archaeological Data Preservation Act. In addition, any proposal for development must comply with all applicable Federal regulations, including:

1. Noise Control Act of 1972 (Public Law 92-574);

2. Federal Water Pollution Control Act (Public Law 84-660) as amended by Public Law 92-500 in 1972;

3. Clean Air Act of 1970 (as amended by Public Law 91-604);

4. Reservoir Salvage Act of 1960 (Public Law 86-523) as amended in 1974;

5. Endangered Species Act of 1973 (Public Law 93-205);

6. Executive Order 11593 (Protection and Enhancement of the Cultural Environment);

7. Uniform Relocation Assitance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646);

8. Fish and Wildlife Coordination Act of 1958.

Criteria for Water Supply Concepts

It was concluded that the water supply concepts would include combinations of the following potential features or actions: enlargement of the existing Gross Reservoir, and expansion of the Williams Fork collection facilities of the DWB's existing transmountain Moffat system; enlargement and use of the Corps of Engineers' existing Chatfield Dam and Reservoir; construction of the potential Two Forks Dam and Reservoir on the South Platte River; development of the potential modified Eagle River collection system; development of additional Blue River collection facilities; acquisition of additional water rights by the DWB in Bear Creek and the South Platte River, and the exchange of treated sewage effluent from Denver for downstream agricultural water. The concepts also utilized existing collection, transmission, and storage facilities.

The concepts were formulated using data compiled on previous investigations, including that of private consulting firms, engineering reports, and environmental assessments on DWB proposed project features, and on Bureau of Reclamation and Corps of Engineers investigations and reports. Primary reference material is listed in the bibliography. No additional detailed studies were made on any potential features.

Each concept described was formulated to provide enough raw water to satisfy the annual raw and treated water demand of the DWB at the time the full Foothills Treatment Plant capacity of 500 mgd is projected to be required. This amounts to the existing 520 mgd treatment capacity, plus the future additional treatment capacity of 500 mgd, making a total of 1,020 mgd water treatment capacity available to the DWB service area.

The DWB has developed procedures using population projections, historic temperature and precipitation data, and historic water-use patterns to estimate the treated water supply needed to meet maximum hourly, daily, and annual demands and to determine when 1,020 mgd treatment capacity (the system's capacity with Foothills implemented at 500 mgd) would be required. Historically, part of the developed raw water supply has been delivered untreated to DWB raw water contractors. Estimates of the raw water requirement at the time the additional 500 mgd would be needed are 378,400 acre-feet for treatment and 27,200 acre-feet for raw water delivery, totaling an average annual raw water requirement of about 405,700 acre-feet at the treatment plant intakes and raw water delivery points. This 405,700 acre-feet was used as a target for all raw water supply concepts developed in this section.

The raw water supply concepts were formulated to combine existing and potential features, including Strontia Springs Dam, to provide for the collection, transmission, and regulatory storage of the raw water to meet the total treated and raw water requirements.

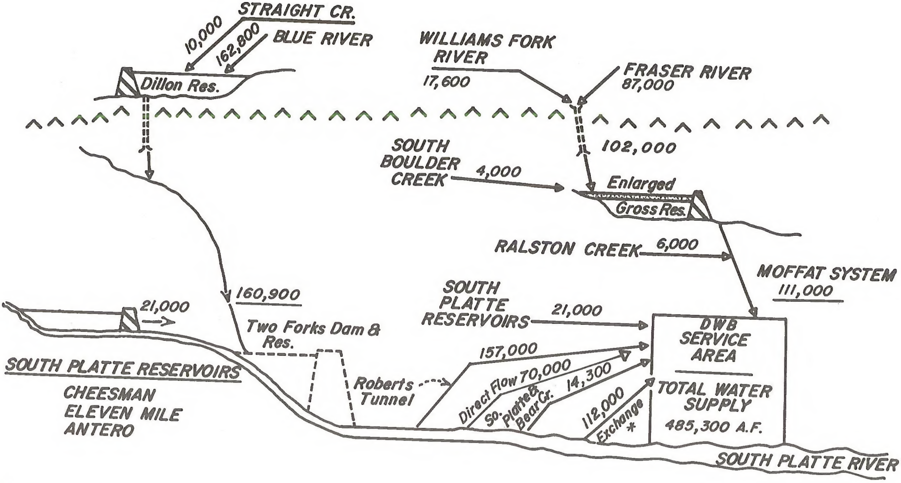
The water supply figures developed for each concept were not determined by actual operation studies, but are considered to be within about 20 percent of the raw water demand. Minimum streamflow requirements, sewage effluent exchange criteria, and supplies derived from water rights acquired but not yet fully defined, may reduce the estimated water supplies in the concepts presented.

Concepts

Concept A

General

This concept, shown on Map 1, would permit the DWB to use more water from its west slope Moffat system; expand its west slope Roberts Tunnel system; and provide additional terminal storage facilities, acquire new water rights, and exchange treated Denver sewage effluent for agricultural water within its east slope South Platte River water supply system. From a structural standpoint, the concept would involve enlargement of the existing Gross Reservoir (Moffat), construction of the potential Two Forks Dam and Reservoir on the South Platte River, and construction of new facilities on Straight Creek to divert additional Blue River tributary water into Dillon Reservoir (for the Roberts Tunnel system). The combination of these features and operation modifications would provide



*Exchange includes acquired water rights

NOTE: ALL NUMBERS IN ACRE-FEET

WATER SUPPLY SCHEMATIC

CONCEPT A

FIGURE 8-3 *Rev. 5/13/77*

a total of about 485,300 acre-feet of raw water for the Denver metropolitan area. Approximately 173,000 acre-feet of this would be new water provided under Concept A. Figure 8-3 and Table 8-4 show the amount of water provided by each feature and source.

TABLE 8-4

CONCEPT A WATER SUPPLY

	Water Supply acre-feet		
Feature and source	Present dependable supply	Increase	Concept A Total
Moffat system with Gross enlargement	92,000	19,000	111,000
Roberts Tunnel with Straight Creek	124,000	33,000	157,000
South Platte System			
Reservoir Storage	12,000	9,000	21,000
Direct Flow	70,000	0	70,000
Exchange	-	112,000	112,000
South Platte River and Bear Creek Ditch rights	14,300	0	14,300
Total	312,300	173,000	485,300

Enlargement of Gross Reservoir would improve the overall operational efficiency of the west slope Moffat system, which consists of water collection facilities on the upper tributaries of the Williams Fork and Fraser Rivers.

Another facet of the concept would be the construction of a collection system on Straight Creek whereby additional water could be collected and diverted to Dillon Reservoir. Water from Dillon Reservoir could then be conveyed through the Roberts Tunnel to the North Fork of the South Platte River, where it would be stored and reregulated in the potential Two Forks Reservoir. When released for downstream requirements, it would be diverted by Strontia Springs Diversion Dam located about 3.5 miles downstream, then conveyed through a tunnel to the Foothills Treatment Plant, and finally, to the Denver metropolitan area for use.

The third facet of this concept would be the purchase by DWB of water rights presently used for agricultural purposes downstream of the

Denver metropolitan area be stored and diverted by DWB in exchange for treated sewage effluent.

Description

Features and Operation

South Platte River System. Two Forks Dam and Reservoir would be located on the South Platte River below its confluence with the North Fork in Jefferson and Douglas Counties, sec. 30, T. 11 S., R. 69 W., about 24 air miles southwest of Denver.

Based on a reconnaissance evaluation, a storage capacity of 305,000 acre-feet would be necessary to regulate 172,800 acre-feet from the Roberts Tunnel system (Straight Creek) and 203,000 acre-feet from the South Platte system. The reservoir would also regulate waters acquired through purchase and through exchange of sewage effluents. In addition, dead storage capacity of about 25,000 acre-feet would be provided. A surcharge pool of about 220,000 acre-feet would be needed to control the inflow design flood. Maximum water surface would be 7,515 acres at an elevation of 6,457 feet.

The Two Forks Dam would be a concrete-arch structure, with a height above streambed of 444 feet. An ungated spillway would be provided with a capacity of 32,400 cfs. The outlet works to release water for municipal and industrial use would have a capacity of about 5,200 cfs. Approximately 10,000 acres of rights-of-way would be required for construction of the dam and reservoir.

As Two Forks Reservoir would provide terminal regulatory storage for DWB on the South Platte, certain restrictions on its use would be necessary to maintain high quality water for municipal and industrial use. In this concept, it was assumed that very limited recreational use of the reservoir would be allowed. Only the minimum of access roads and recreational facilities would be provided. There would be no power-boating or body contact sports, and all camping areas, picnic areas, etc., would be provided with vault-type toilet facilities, for periodic removal. Insecticide and other chemical treatments within the immediate watershed would be prohibited. Strong anti-litter control measures would be enforced. Two Forks Reservoir recreational facilities and lands would be under the control of the Forest Service; day-use by the public could be limited.

Two Forks Reservoir would be operated to regulate the South Platte River and transmountain diversions. On an annual basis, 172,800 acre-feet would be diverted from Dillon Reservoir through the Roberts Tunnel and conveyed by the North Fork of the South Platte River to the Two Forks Reservoir. Maximum water storage in the existing South Platte River reservoir system (Cheesman, Elevenmile Canyon, and Antero) would be maintained in the highest reservoir whenever possible to increase the yield on a long-term basis. Only the minimum river releases needed below each reservoir to meet senior downstream water rights would be provided. Diversion of flows into the North Fork channel would be coordinated with natural flow conditions to minimize degradation and flooding.

Roberts Tunnel System. The next collection system is located on Straight Creek, a tributary of the Blue River, about 1.5 miles northeast of Dillon. It would consist of a diversion structure approximately six feet high and 60 feet long. The water would be conveyed in a 75-cfs underground conduit four feet in diameter, about two miles long, to Dillon Reservoir. The conduit alignment would follow the old Oro Grande Canal No. 1 and No. 2 at about elevation 9300.

The system would divert Straight Creek waters primarily during spring and would yield approximately 10,000 acre-feet a year.

The average annual streamflow in Straight Creek below the diversion point for about 3.5 miles would be reduced by 14 cfs. The flow above the Straight Creek diversion has averaged about 16 cfs annually.

The flow in the Blue River from Straight Creek to Green Mountain Reservoir would also be reduced by an average of 56 cfs during the diversion period. The average flow in this 22-mile reach of the Blue River would range from 500 cfs near the junction with Straight Creek to 1,000 cfs at Green Mountain Reservoir during the diversion period.

The current operation of Dillon Reservoir would change when terminal storage at Two Forks Reservoir becomes available on the South Platte River. Water releases would be increased through the Roberts Tunnel into the North Fork of the South Platte during the summer, fall, and winter. These increased releases would cause the water level in Dillon Reservoir to decrease by an average of 74 feet. This would reduce the surface area from 3,233 acres to 1,416 acres. Spills from Dillon Reservoir, which normally occur in the early summer, during wet years would be decreased.

Moffat System. Gross Dam and Reservoir was completed in 1954 to store a total capacity of about 43,065 acre-feet. The potential enlargement would raise the height of this structure from 340 feet to 453 feet, and increase the conservation capacity to 113,000 acre-feet.

The surface area of Gross Reservoir at maximum storage capacity is 432.1 acres; the surface area of the enlarged reservoir would be 803.5 acres. The present reservoir has a shoreline of 9.9 miles, while the enlarged reservoir would have 12.1 miles of shoreline and would inundate approximately an additional 3,000 feet of South Boulder Creek, at the upper end of the reservoir. It is anticipated that the present limited recreational use of the land surrounding the reservoir would be continued. No relocation of roads would be necessary. Construction materials for the enlarged structure are obtainable from nearby borrow areas.

The projected operation of the enlarged Gross Reservoir would be very similar to current operations except that the present maximum water-surface elevation (7,827 feet) would reach a higher elevation (7,400 feet) during the spring and summer. The operation would continue in its current pattern during the winter and fall.

With the enlargement of Gross Reservoir, future diversions from the DWB's west slope Williams Fork-Fraser water collection system would be greatly increased. The annual historical diversions from the Fraser River system of about 48,000 acre-feet would be increased to approximately 87,000 acre-feet. Present Williams Fork system diversions would be increased, from a present average of approximately 5,000 acre-feet to 17,600 acre-feet annually. This increased Williams Fork River collection would also increase the base flow in a 3.5-mile reach of Vasquez Creek, between Vasquez Tunnel and the Fraser River collection facility, by 18 cfs.

The total increased yield from these two collection systems, with Gross Reservoir enlargement, would average about 52,000 acre-feet annually. This would require all collection facilities to be operated continually during the water year.

The average annual flow of the 18.3-mile reach of South Boulder Creek between the east portal of the Moffat Tunnel and Gross Reservoir would increase from 72.5 cfs to 144.5 cfs, 52,000 acre-feet.

With increased diversions by DWB's collection and storage facilities on the Fraser, Williams Fork, and Blue Rivers, more replacement and exchange releases from Williams Fork Reservoir could be made to accommodate downstream senior rights.

Present Environment

Soils and Terrestrial Resources. The soils in the South Platte River System area are generally well-drained and located on moderately to highly sloping relief. The predominant parent materials are igneous, Pike's Peak granite, and metamorphic, gneiss and biotite schist. Soils are mostly light-textured, sand to sandy loam, and frequently gravelly. Rock talus, pieces of cobble-sized granite, often dominate the canyon bottom. Soils of the south-facing slopes tend to be thinner than those on north-facing slopes, which have more vegetation and have undergone less erosion (BR 1973). A more detailed description of soils follows under a separate heading.

Concept B

General

Concept B, shown on Map 8-2, would be the same as Concept A, except that the existing Corps of Engineers Chatfield Dam and Lake would be enlarged to accommodate east slope municipal and industrial terminal conservation storage, in lieu of building the potential Two Forks Dam and Reservoir for this purpose.

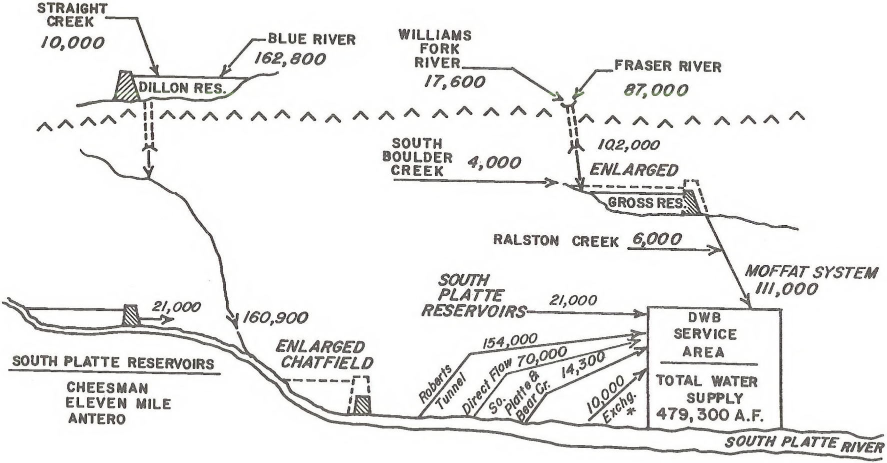
The features and plans of Concept B, like those of Concept A, would be enlargement of the existing Gross Dam and Reservoir, additional Blue River water diversion facilities (Straight Creek collection system), the acquisition of new water rights, and the exchange of treated Denver sewage effluent for agricultural water.

The description of the like features, their operations, and environmental impacts are given under the discussion of Concept A; therefore, they are not repeated here.

The combination of Concept B features and operational modifications would provide about 479,300 acre-feet total of raw water to the Denver metropolitan area, as shown on Figure 8-4 and Table 8-8.

In Concept B, Chatfield Dam and Lake would be used as the principal east slope facility for storing municipal and industrial water for treatment by the Foothills Treatment Plant, and eventual use in the Denver metropolitan area. The enlargement of Chatfield Dam and Lake would also provide for flood control downstream of the structure, and minimal recreation facilities would be constructed. Congressional authorization would be required to modify the existing Chatfield Dam and Lake to provide for new or revised project operations or functions.

About 305,000 acre-feet of storage capacity would be adequate to regulate the South Platte and Blue River flows as well as store and regulate agriculture water purchased and exchanged for treated sewage effluent from the Denver metropolitan area. In arriving at this concept, three options for using Chatfield were considered. These were: (1) eliminating the present flood control capacity in Chatfield Lake completely and drastically reducing the surcharge capacity, using this space for municipal and industrial conservation



*Exchange includes acquired water rights

NOTE: ALL NUMBERS IN ACRE-FEET

WATER SUPPLY SCHEMATIC

CONCEPT B

Rev. 5/13/77

FIGURE 8-4

TABLE 8-8

CONCEPT B WATER SUPPLY

Feature and source	Water Supply acre-feet Present dependable supply	Increase	Concept B Total
Moffat system with Gross enlargement	92,000	19,000	111,000
Roberts Tunnel with Straight Creek	124,000	30,000	154,000
South Platte System			
Reservoir Storage	12,000	9,000	21,000
Direct Flow	70,000	0	70,000
Exchange	--	109,000	109,000
South Platte River and Bear Creek Ditch rights	14,300	0	14,300
Total	312,300	167,000	479,300

storage, (2) replacing the flood control storage with municipal and industrial conservation storage and constructing dams upstream on Plum Creek and the South Platte River for flood control purposes, and (3) enlarging Chatfield Dam and Lake to include 305,000 acre-feet of municipal and industrial conservation storage in addition to the existing 215,000 acre-foot flood control capacity, 120,000 acre-foot surcharge capacity, and 20,000 acre-foot sediment capacity.

There would be a number of detrimental effects associated with any of the above options. Using Chatfield Lake as a terminal municipal and industrial water supply reservoir would greatly increase the cost of treating the water. Water stored in Chatfield Lake would have to be pumped back upstream to the Foothills Treatment Plant. Strict environmental controls would be necessary to handle waste from the recreation facilities, weed control operations, and general maintenance of the recreation lands around the reservoir. Recreation opportunities would be greatly reduced, as no motor boating, swimming, or other body contact recreational activities would be permitted. Many permanent facilities, including highways, railroad, power lines, and houses, would require relocation because of the wide fluctuation of the reservoir water surface elevation.

In addition to the above, eliminating the flood control capacity and replacing it with municipal and industrial conservation capacity, as suggested in alternative (1) above, would probably necessitate new flood control operation procedures and require greatly increased channelization through the Denver metropolitan area.

The second alternative, in which flood-control dams and reservoirs would be constructed upstream and the flood-control capacity in Chatfield Lake would be converted to municipal and industrial conservation, would involve considerable cost from the construction of new structures. Environmental and social impacts from the construction would be extensive.

Significant costs and socio-economic impacts would also result for alternative (3), whereby the dam and lake would be enlarged to accommodate the additional conservation capacity.

Description

Features and Operations

The third alternative of enlarging Chatfield Dam and Lake was selected for inclusion as part of Concept B because it would still retain the flood control function of the existing structure, provide municipal and industrial water storage and regulation, and have fewer environmental impacts than constructing flood control dams upstream. The following tabulation gives statistical data on the present and enlarged (Concept B) Chatfield Dam and Lake (Table 8-9).

Closure of the present structure occurred in 1973. It is an earth-filled dam about 150 feet high and 13,340 feet long. The proposal to add about 305,000 acre-feet of conservation space would require adding 42 feet to the height and 3,660 feet to the length of the dam. The total reservoir capactiy would then approach 660,000 acre-feet. Present assigned capacity for sediment, flood control, and surcharge would remain unchanged. The enlarged reservoir would require an additional 3,500 acres of rights-of-way. About 100 acres of land would also be required to construct underground conduits and the pumping plant to transport water from Chatfield to the Foothills Treatment Plant.

Enlargement of Chatfield Dam and Lake would require major relocations of existing real property and inundation of several thousand acres of lands adjacent to the reservoir now being subdivided for residential and light industrial uses. Relocation would include the community of Waterton and the DWB Kassler water treatment plant, approximately 9 miles of the Highline Canal, 4.6 miles of State Highway 75, 1.5 miles of Deer Creek Canyon Road, and 4 miles of county roads. In addition, relocation of railroads, transmission lines, natural gas lines, and water supply facilities would be required.

A pumping plant and buried conduit would be necessary to convey water from Chatfield Lake to the proposed Foothills Treatment Plant. The pumping plant would be located on the right embankment of Chatfield Dam and would have a capacity of 750 cfs with the pool at the minimum elevation of 5,426 feet. Two parallel 84-inch-diameter conduits would transport the pumped water 6 miles southwest to the Foothills Treatment Plant. The pumping plant would be designed for a total dynamic head of 550 feet, and would require a maximum electric power demand of 55 megawatts. The parallel conduits would pass beneath the enlarged Chatfield Lake for a distance of approximately one mile.

The enlarged reservoir would regulate waters from the Blue and South Platte Rivers, provide for better use of the DWB direct flow rights, agricultural water rights purchased, and agricultural water obtained in exchange for treated sewage effluent from the metro sewage plant. The reservoir would reach its maximum surface elevation each June, followed by a steady decline to a minimum elevation sometime in December. The water level would fluctuate between elevations 5,517 and 5,485 annually and could drop to 5,426 during periods of extreme droughts or floods.

TABLE 8-9

CHATFIELD DAM AND LAKE

	Existing	Enlarged
Total capacity (acre-feet)	355,000	660,000
Surcharge capacity (acre-feet)	120,000	120,000
Flood control capacity (acre-feet)	215,000	215,000
Conservation capacity (acre-feet)	0	305,000
Sediment capacity (acre-feet)	20,000	20,000
Maximum water surface elevation (feet msl) 1/	5,522	5,563
Top of conservation (feet msl) 1/	5,426	5,517
Area at top of conservation (acres)	1,150	5,826
Additional rights-of-way (acres)	———	3,500
Top of dam (feet msl) 1/	5,528	5,570
Crest length (feet)	13,340	29,000 2/
Height of embankment (feet)	150	192
Additional inundated streams (miles)		
South Platte River	———	5
Plum Creek	———	3
Deer Creek	———	1
Shoreline (miles)	10	26
Conservation pool fluctuation (feet)	4	91

1/ msl = mean sea level.

2/ Includes 12,000 foot dike section.

Chatfield Lake would store water originating in the South Platte Basin as well as west slope water transported through the Roberts Tunnel. An average of 160,900 acre-feet annually would be diverted through Roberts Tunnel and conveyed by the North Fork of the South Platte River. Flows downstream of Strontia Springs Dam would be dependent on the operation of the Foothills Treatment Plant. Flows would be at least equal to those necessary to meet downstream senior water rights not involved in exchange; generally, flows would be greater, as waters would be stored in Chatfield Reservoir.

Raw water would be diverted from the lake to a pumping plant and from there to the Foothills Treatment Plant, located about 6 miles southwest of Chatfield Dam. The pumping plant would be operated in one of two ways, (1) to supply, as a base load plant, a constant supply of water to the Foothills Plant for treatment, (2) or to deliver water to a peaking facility, pumping large quantities of water from May through September to meet the peak water demands.

Chatfield Lake contains water of relatively high quality (Corps of Engineers 1974). The water quality of the South Platte River is monitored at the Kassler Water Treatment Plant by DWB. Results of this monitoring show that the water is within the water quality criteria for raw water for municipal use (DWB 1973, 1974, 1975, and 1976).

As with Concept A, restrictions on public use including elimination of body contact sports and limitation of boating to nonpower craft would be necessary to protect the quality of the water. Sewage treatment facilities for minimum base recreation facilities would be required to eliminate contamination of water. Insecticide and other chemical treatments within the immediate area would be prohibited. Strong anti-litter control measures would be enforced.

Under Concept B, Cheesman Reservoir would continue to provide terminal storage for Denver's South Platte River water supply. Maximum water storage in the existing South Platte River reservoir system, Cheesman, Elevenmile Canyon, and Antero, would be maintained in the highest reservoir whenever possible, to optimize yield on a long-term basis. Minimum river releases below each reservoir would be provided to meet senior downstream water rights. Diversion of flows into the North Fork channel would be coordinated with natural flow conditions to minimize degradation and flooding.

Concept C

General

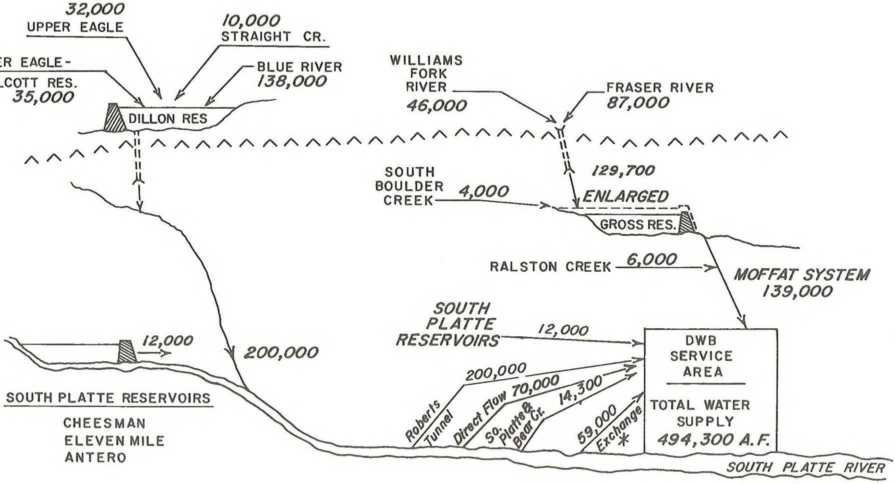
Concept C, shown on Map 8-3, would consist of a new water collection and storage system on the Eagle River to divert water into Dillon Reservoir (Roberts Tunnel System). It would also expand the existing Williams Fork collection system (Moffat System) and enlarge Gross Dam and Reservoir, provide new collection facilities on Straight Creek, purchase existing agricultural water rights for municipal and industrial use, and exchange treated sewage effluent from the Denver metropolitan area for agricultural water. Concept C would provide a total of approximately 494,300 acre-feet of water for municipal and industrial use by the Denver metropolitan area as shown in Figure 8-5 and in Table 8-10.

TABLE 8-10

CONCEPT C WATER SUPPLY

	Water Supply acre-feet		
Feature and source	Present dependable supply	Increase	Concept C Total
Moffat system with Gross enlargement	92,000	47,000	139,000
Roberts Tunnel with Straight Creek and Eagle Diversion	124,000	76,000	200,000
South Platte System			
Reservoir Storage	12,000	0	12,000
Direct Flow	70,000	0	70,000
Exchange	-	59,000	59,600
South Platte River and Bear Creek Ditch rights	14,300	0	14,300
Total	312,300	182,000	494,300

Information on the physical and operation aspects of the enlarged Gross Dam and Reservoir, the collection facilities on Straight Creek, and the purchase and exhange of agricultural water rights given under the discussion on Concept A is also applicable to this concept; this information is not repeated here.



*EXCHANGE includes acquired water rights

NOTE: ALL NUMBERS IN ACRE-FEET

WATER SUPPLY SCHEMATIC

CONCEPT C

FIGURE 8-5

Rev. 5/13/77

In Concept C, Dillon Dam and Lake would be used as the principal storage facility for regulating municipal and industrial water for treatment. No new regulatory storage would be provided in the South Platte River System.

The physical and operational description associated with expansion of the existing Williams Fork collection system and the new water collection and storage system on the Eagle River are discussed in the following pages.

Description

Features and Operation

Roberts Tunnel System (Eagle River Area). The plan would be to collect water from the Eagle River by pumping from the river near Wolcott into a reservoir and by gravity diversions from upper Eagle River tributaries above Minturn and Redcliff. These diverted flows would be conveyed in an easterly direction by both pressure, gravity tunnels, and conduits under the White River National Forest and the Gore Mountain Range into the north fork of Tenmile Creek, which flows into Dillon Reservoir. The water would be delivered from Dillon into the north fork of the South Platte River by the Roberts Tunnel. The principal features of this plan would be the Wolcott Dam and Reservoir, Eagle River Diversion Dam and Pumping Plant, Wolcott-Dillon Tunnel and Ute Creek Pumping Plant, and the Homestake-Dillon Tunnel.

Wolcott Dam and Reservoir would be located on Alkali Creek about 1 mile north of the town of Wolcott. A total storage capacity of 135,000 acre-feet would be required to regulate diverted river water at this site. The Eagle River Diversion Dam and Pumping Plant located on the Eagle River would divert water into Wolcott Reservoir through a 5,000-foot-long buried pressure conduit. From the reservoir, another buried conduit would convey water by gravity pressure to Ute Creek, where another pumping plant would discharge flow into the Wolcott-Dillon Tunnel. The Ute Creek Pumping Plant would have a total pump lift of about 2,000 feet. The Wolcott-Dillon Tunnel would be over 32 miles long, and would range in diameter from 7 to 10 feet.

The other collection system, called the Homestake-Dillon Tunnel, would collect waters from Turkey Creek, Wearyman Creek, Resolution Creek, and other upper Eagle River tributaries and join the Wolcott-Dillon Tunnel at a point about 6.9 miles from the exit portal. The Homestake-Dillon Tunnel, with a total length of over 26 miles, would convey water entirely by gravity and would require a small diversion structure on each tributary.

A statistical summary of these features is shown below:

TABLE 8-11

ROBERTS TUNNEL SYSTEM

Potential feature	Quantity
Wolcott Dam and Reservoir	
Total conservation capacity (TCC)	125,000 ac-ft
Total storage capacity	135,000 ac-ft
Surface area at TCC	1,505 acres
W.S. elevation at TCC	7,330 feet
Minimum river release	natural inflow
Height of dam (above streambed)	276 ft
Crest length of dam	2,700 ft
Elevation, top of dam	7,338 ft
Eagle River Diversion Dam and Pumping Plant	
Height of dam	27 ft
Crest length	225 ft
Elevation, top of dam	6,920 ft
Pumping plant capacity	840 cfs
Length of discharge line	5,030 ft
Wolcott-Dillon Tunnel	
Capacity	72 cfs
Length	172,705 ft
Diameters	7 to 10 ft
Pumping plants	Ute Creek (1)
Homestake-Dillon Tunnel	
Capacity (minimum to maximum)	1-340 cfs
Length (26.4 miles)	139,250 ft
Diameters, varies from	2.5 to 8.83 ft

At a point about 19 miles east of Wolcott Reservoir, the Wolcott-Dillon Tunnel would pass under the Eagle's Nest Wilderness boundary approximately 235 feet below the existing ground surface. From this point, about 12.9 miles of the tunnel would be constructed underground through the wilderness area boundaries. The tunnel would be constructed about 80 feet below the natural ground surface at the eastern wilderness boundary, which is approximately 1/2 mile west of the tunnel's east portal.

The Homestake-Dillon Tunnel would be 75 feet underground entering the wilderness area. From this point, the remaining 1.7 miles of tunnel would be an average of 150 feet below the Eagle's Nest Wilderness surface area to where it connects into the Wolcott-Dillon Tunnel. About 7 percent of the tunnel's total length would be constructed under the wilderness area.

About 5.5 miles of new highway would be required to be constructed to replace a portion of the existing State Highway 131 that would be inundated by the potential Wolcott Reservoir.

Wolcott Dam could be constructed with selected earth material from borrow areas just north of the damsite, and within the conservation pool. Excavation from the Wolcott-Dillon Tunnel, amounting to about 850,000 cubic yards, would be hauled out both the western and eastern portals as well as through three construction adits along the tunnel alinement. The eastern portal disposal area would be on DWB land adjacent to Dillon Lake. All other disposal areas would be outside the wilderness area. Excavation from the Homestake-Dillon Tunnel would be about 460,000 cubic yards. Disposal areas for this tunnel waste would be in the south portal area and through several construction adits, all of which would be outside the wilderness area boundary.

New 20-foot-wide gravel access roads required to build the above features would total about 12 miles. Access to the western end of the Wolcott-Dillon Tunnel would require about 4 miles of new road from relocated State Highway 131. In addition, about 6 miles of access road would be required to the Wolcott-Dillon Tunnel construction staging and adit areas from U.S. Highway 70 and 6. About 2 miles of improved and new access roads would be required to build the Homestake-Dillon Tunnel.

The average annual energy required for pumping at the Eagle River and Ute Creek plants would be about 117 million kwh. Electrical transmission facilities would consist of an additional 230/115 kV transformer, and about 3 miles of new 115 kV transmission line, from the existing Wolcott Substation to the Eagle River and Ute Creek Pumping Plants. This substation, located on the south side of Interstate Highway 70 near Wolcott, is owned by the Colorado Ute Electric Association. Power is transmitted to the existing substation by a 230-kV line from the coal-fired Colorado Ute power station near Hayden, Colorado.

Waters of the Eagle River watershed available to DWB would be diverted where possible by gravity and the remainder could be diverted near Wolcott by the pumping plant. The Eagle River pumping plant would operate during the months of May through July. These waters would be stored in Wolcott Reservoir and pumped during nine months of the year through the Wolcott-Dillon Tunnel. The pumping and gravity diversions from the Eagle River would be fully integrated with the operation of the Blue River collection system and the Roberts Tunnel diversion, to optimize the water yield in the respective basins and to minimize pumping costs. The following tabulation shows the historic and future streamflows affected by the potential Eagle River collection system.

TABLE 8-12

STREAMFLOWS IN EAGLE RIVER COLLECTION SYSTEM

Stream	Quantity
Eagle River	
Miles affected (below Eagle River River Diversion Works)	23
Historic flows Average (1964-1973)	561 cfs
Future flows Average	465 cfs
Eagle River tributaries	
Miles affected	29.1
Accumulative historic flows Average	47 cfs
Accumulative future flows Average	3 cfs

The average water yield from the Upper Eagle gravity system would amount to about 32,000 acre-feet per year. The remaining tributary water which would flow into the Eagle River, to be diverted by the Wolcott Diversion Dam and pumping plant into Wolcott Reservoir, would provide an average annual water supply of approximately 35,000 acre-feet. Thus, a net total of approximately 66,000 acre-feet of water would be obtained from this potential collection system, which does not include the 10,000 acre-foot yield from Straight Creek Diversion.

The normal water surface drawdown in Wolcott Reservoir would be about 25 feet a year, dropping from a high elevation of 7,330 in mid-summer to a low of 7,305 in late winter. The normal water surface area would vary from 1,505 to 1,350 acres on a seasonal basis. Although the reservoir would have about three years of holdover storage capacity (125,000 acre-feet), to protect against prolonged dry periods, extreme drawdowns could be expected.

Moffat System (William Fork River Area). The expanded Williams Fork Collection System would consist of a dam and reservoir on the South Fork of the Williams Fork River (South Fork Dam) to collect upstream runoff from the basin, a gravity tunnel and a closed gravity conduit to convey the stored South Fork water to a pumping plant which would be located near the Williams Fork River, and a pressure conduit to transport South Fork water to a closed gravity conduit. This gravity conduit would convey the South Fork water to the existing collection system (Gumlick Tunnel) as well as collect runoff from eleven small tributaries of the north slope of the Williams Fork River Basin.

These tributaries are located between Darling Creek and McQueary Creek. The water obtained from the South Fork and the eleven tributaries would be added to that of the existing Williams Fork Collection System. New appurtenant facilities would include access roads and power lines.

The axis for the South Fork Dam site would be 1.6 miles upstream from the mouth of the South Fork of the Williams Fork River. The elevation of the streambed at the dam axis is approximately 9,045 feet. The total capacity of the reservoir would be 13,000 acre-feet. The area inundated by the reservoir would be 160 acres. The potential dam would be about 195 feet high with a crest length of 1,700 feet.

A diversion tunnel would bypass the stream during construction of the dam and later be incorporated as part of the reservoir's emergency spillway. Embankment material for the dam could be obtained from borrow areas located downstream.

The tunnel and closed conduit from the reservoir to the pumping plant would operate by gravity and would be approximately 1.5 miles long.

The pumping plant site is in a flat area on the north bank of the Williams Fork River 0.2 mile downstream from its confluence with the Middle Fork, approximately 400 feet from the river. The elevation at the site is approximately 9,050 feet.

The pressure discharge line from the pumping plant to the gravity conduit would be made of steel pipe 0.8 mile long. Most of the pipe would be buried, although some of the pipe would be elevated on concrete piers. An energy dissipating structure would be required where the discharge line joins the gravity conduit. The proposed location for this structure is alongside the existing North Fork road.

The north slope gravity conduit would extend from a tributary of Darling Creek to McQueary Creek, a distance of about 10 miles. The conduit would carry water under open-channel flow conditions. The existing conduit from the Gumlick Tunnel inlet to McQueary Creek, a distance of 1.5 miles, would be removed and replaced with a larger diameter pipe. The north slope gravity system would also require new diversion structures for those streamflows being collected between McQueary Creek and Darling Creek tributaries. Backfill material for construction of the conduit could be obtained from borrow sites along the existing North Fork road. Improvements in the existing North Fork road would also be necessary.

New access roads required would include approximately 1 mile reach of gravel road 20 feet wide from the existing Sugarloaf Campground road to the pumping plant and approximately 4.5 miles of gravel road 16 feet wide switching back and forth across the pressure discharge line from the pumping plant to the gravity conduit.

Electrical power transmission facilities would include a new single-pole line 1.8 miles long from the existing substation near the west portal of the Henderson Tunnel to the pumping plant and a single-pole line 2 miles long from the same substation to the South Fork Dam. For the most part, the power lines would be constructed next to access roads in the area.

The operation of the expanded William Fork collection system would be consistent with Colorado water law and other legal agreements, the need for additional water in Denver, and the capacity of the DWB's system to transport and store the water.

Runoff forecasting and other water resource management techniques would be used to determine the need for additional Williams Fork water. If it is determined that runoff from other sources is adequate, little or no water would be pumped from the South Fork Reservoir. The amount and timing of water pumped from the South Fork Reservoir would also be dependent on the demand for raw water.

The dam and reservoir on the South Fork of the Williams Fork River, the collection of water from the eleven tributaries of the north slope of the Williams Fork River Basin, and the enlarged Gross Reservoir would develop a total of 46,000 acre-feet of water. The new storage and collection facilities would account for 28,400 acre-feet of this total.

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